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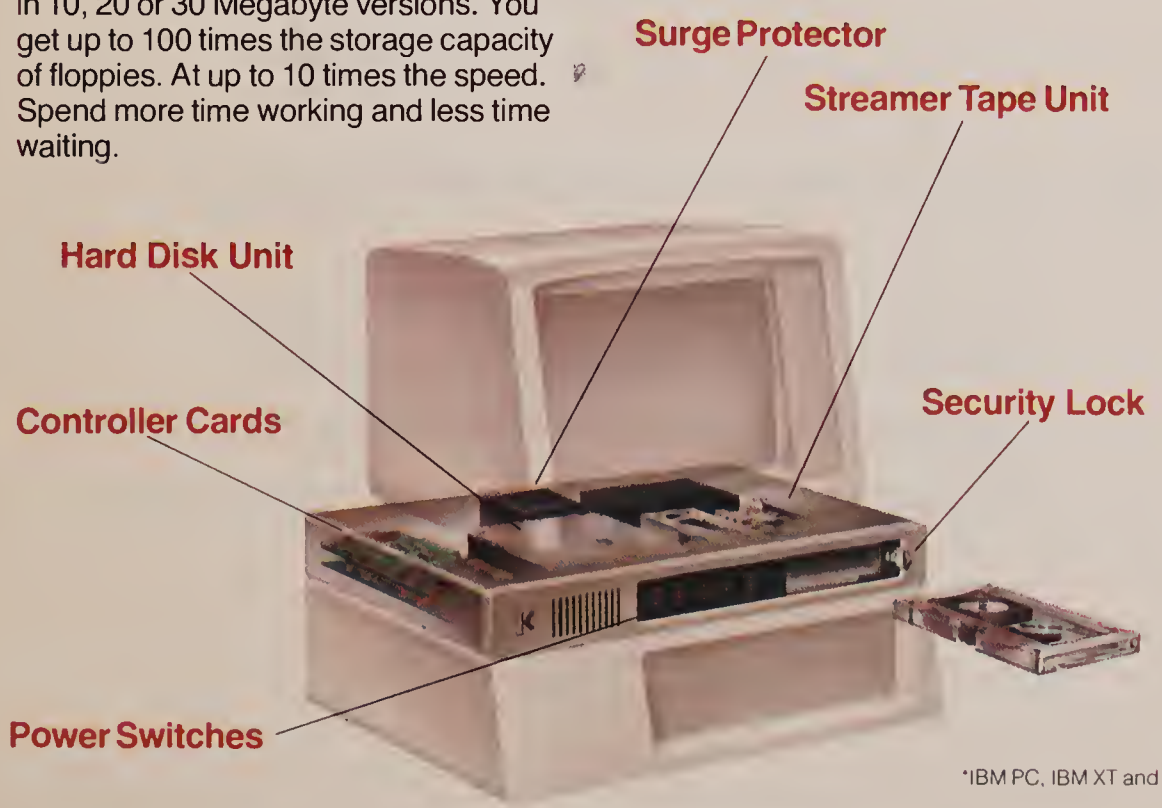

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February 1985

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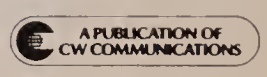

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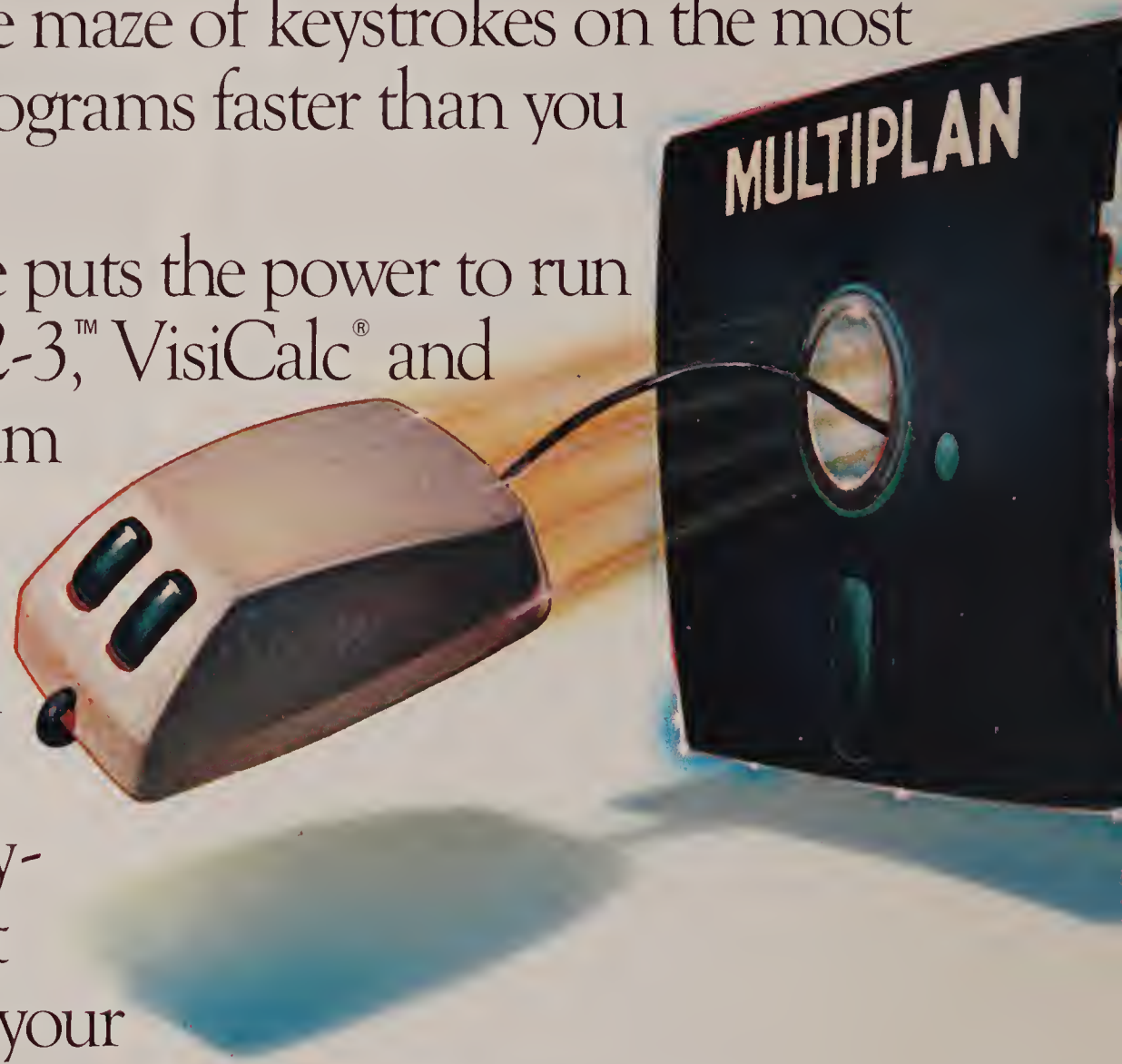

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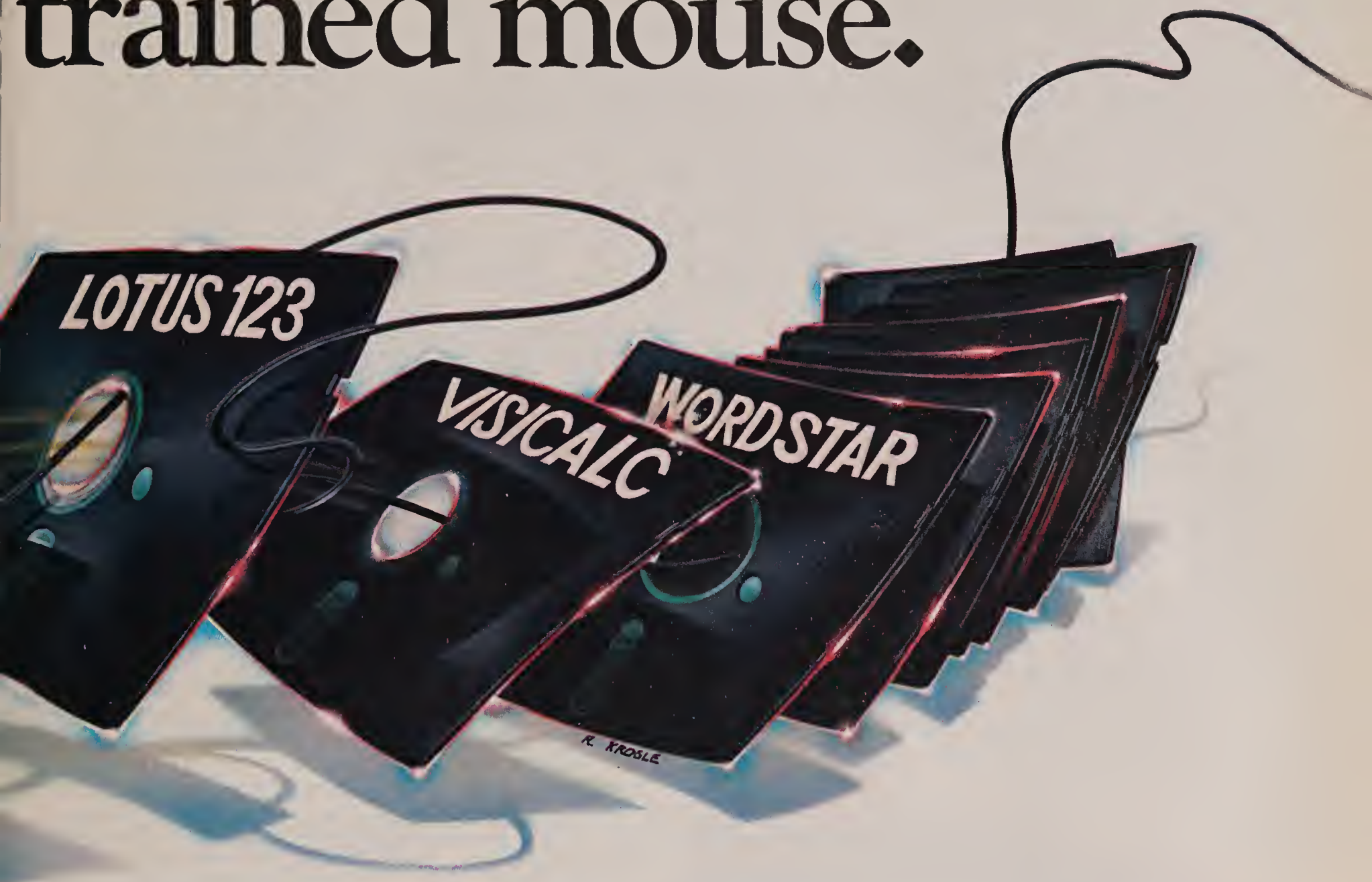

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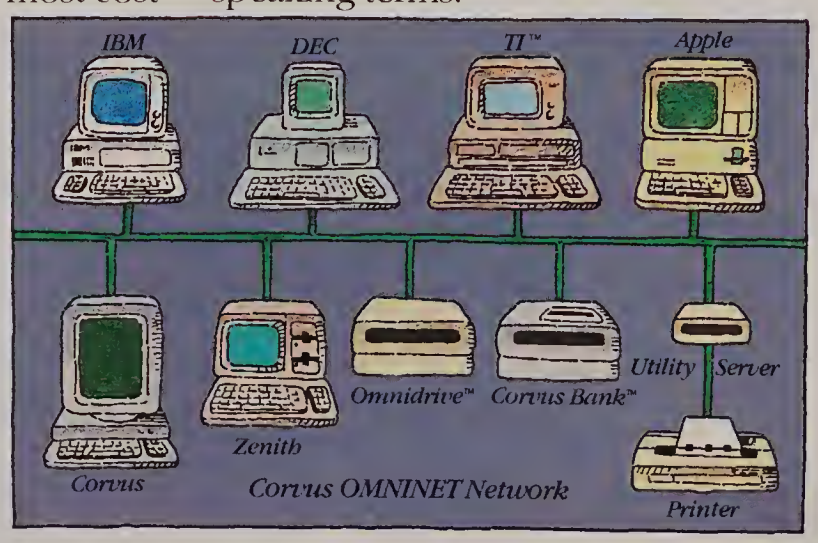

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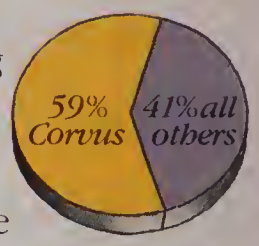

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David Bunnell

A Case of Government Interference?

Bulletin board services are besieged on all fronts—by crafty users, utility companies, and the federal government.

It has often been said that the success of the personal computer is a testimonial to the free enterprise system. Major companies like Apple and Microsoft, in fact, began as dinky two-person operations with few resources but lots of brilliant ideas and an abundance of determination.

According to PC capitalist theory, people who combine good ideas and enthusiasm with a little luck can emerge from nowhere and become millionaires, while creating thousands of opportunities for other citizens.

The real world supports this theory, though there are plenty of instances in which the magic combination was not enough. Reality says that it takes not just a little luck but a whole lot of luck, and even then astronomical success is always subject to instantaneous, inexplicable collapse.

The bottom line is that the personal computer didn't evolve in a totalitarian society, nor is it likely to catch on in such cultures soon.

Thus, it is no surprise that vast numbers of hard-core personal computer users are ardent defenders of unrestrained free enterprise. Thousands of them have rushed to the defense of Thomas Tcimpidis, a TV repairman who ran a free-access computer bulletin board service (BBS) from his home in Los Angeles.

It seems that some unscrupulous person planted illegally obtained telephone credit card numbers on Tcimpidis's system. The phone company discovered this fact through their own BBS snooping program and called the police, who raided Tcimpidis's house, confiscated his personal computer, and charged him with being an accessory to the crime.

This arrest has had a chilling effect on other bulletin board system operators (SYSOPs). Some have simply shut their systems down. Others worry out loud that the spread of personal computer technology has come up against a brick wall.

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phone, we open up amazing new channels and methods of communication. In fact, Tcimpidis's defense strategy has been formulated largely via electronic conferences among attorneys and interested parties throughout the nation.

The key issue is to identify the function of the SYSOP, whether it be an individual or a corporation, such as CompuServe or The Source.

If the SYSOP is the equivalent of a newspaper publisher, then he or she is responsible if any information posted on the BBS is libelous, obscene, or, in the case of credit card numbers or pirated software, illegal.

However, if the SYSOP is providing a communications medium like those that telephone companies and cable TV companies provide, then the SYSOP is not responsible for the messages people post on the system.

The seriousness of this issue becomes clearer when you realize that CompuServe and The Source do not monitor everything that is put into their systems, in part because they don't have the resources to do so.

If the result of this case is that the SYSOP is to be regarded as a publisher, then the thousands of individually operated bulletin boards around the country will most likely cease to exist.

What a shame it would be if the so-called phone phreaks, who represent a tiny minority of personal computer users, were to ruin the party for the rest of us.

In the long run, the phone company would get some sense of satisfaction, but the personal computer phenomenon and its potential to create vast new communications channels would be stopped. Seems like a steep price to pay.

Personal computer users who care about the future development of the PC need to fight government interference wherever it shows up. At the same time we need to repudiate the anarchists in our ranks. The twin wrongheaded notions that long-distance phone access and software should be free to those who are clever enough to steal them represent a threat to our freedom that is as dangerous as that of government control. Thanks to a few crazy people, personal computer history has come to an important crossroads.

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Letters

Reactions and responses from the PC World community

Answer to a Reader's Dreams

To date my PC usage has not included modems or communications software, so I have been inclined to skip articles on those subjects. Now that information has become important to me, and because of my trust in *PC World* I look to your magazine.

A manual search through past issues for pertinent information works but is time-consuming, and I may miss articles by not recognizing those relevant to my search. I believe this situation is common and that the publication of a compiled directory of past articles would benefit your readers.

Steven Green
San Jose, California

PC World *already publishes an annual index of articles. The Index to Volume 1 (1983) was published in the January 1984 issue (*PCW, *Vol. 2, No. 1) and the Index to Volume 2 (1984) appeared in last month's issue (*PCW, *Vol. 3, No. 1). The articles for each year are indexed by subject. A separate index is provided for editorials and for* PCjr World, The Help Screen, *and* Star-Dot-Star.*—Ed.*

The Eternal Macro

Paul McDermott's "The Little Black Book" and "The Little Black Book II" [*PCW,* Vol. 2, Nos. 6 and 7] applied Lotus's *1-2-3* in excellent fashion. The use of the date feature was well illustrated with a limited data base, but the use of another date feature could be noted. For those readers who have clock/calendars or who religiously enter the current date, changing cell P4 to '@YEAR(@TODAY)' in place of '84' will avoid an annual change of that cell location. Also, for consistency column T should be set to 20 characters.

I also found that inserting documented examples of the data query formulas for "complex criteria" in the data query section (cells R32..AB33) was most helpful. This provides a ready reference in the most useful location. (I added more space in the spreadsheet for this reference documentation.)

E. Thomas Robinson
Fairbanks, Alaska

Chess Pieces

With regard to "The Chess Champion of the 8088" [*PCW,* Vol. 2, No. 11], it is somewhat reassuring that the PC, in spite of all the wonderful things it can do, is still little more than a chess patzer (definition: a *woodpusher* or *fish* in chess jargon—a player who makes weak, losing moves).

There are several errors in the notation of the game between *Sargon III* and Julio Kaplan. I reconstructed the correct moves with the aid of the diagrams provided in the article. White's move 12 should be B-QN5, not B-QKn2, as shown. Black's move 18 should be Q-B3 instead of Q-B6, and White's last move should be described as N(R4)xBP. (The symbol *N* to represent the knight is more common in descriptive notation than *Kn,* as used in your listing of the game.)

It is worth noting that some computer chess programs produce printouts of the moves in a game

using nonstandard systems of notation, unlike the algebraic or descriptive systems commonly found in chess literature.

George Huczek
Prince Albert, Saskatchewan, Canada

The picture on page 280 of your article "The Chess Champion of the 8088" shows a *Sargon III* screen layout like the one I get on my IBM PC with *Sargon III*, but pages 282 and 283 show a completely different layout. Are you sure Kaplan didn't beat *Sargon I* or *Sargon II?*

L. Oliver
Pickerington, Ohio

The picture on page 280 shows Sargon III's *monochrome graphics. That screen layout, with the text on the left, is also the layout displayed by any but the latest version of* Sargon III. *The newest version contains a color graphics option that will result in the screen layout shown on pages 282 and 283. All other features of the program remain unchanged. Owners of older versions of* Sargon III *who want the new color graphics can order the new release by calling Hayden Software's Customer Service Department in Lowell, Massachusetts. The toll-free number is 800/343-1218. Updates are available for $10 to current owners of* Sargon III.*—Ed.*

Balancing the Account

The sidebar "Accounting in a Nutshell" ["How to Choose an Accounting Package," *PCW*, Vol. 2, No. 11] contained two fundamental accounting errors. First, the total of all the accounts within the general ledger will rarely equal zero. The difference between the totals of those accounts with debit balances and those with credit balances should be zero. Second, the article stated that accounts payable have a debit balance. Accounts receivable have a debit balance, while accounts payable have a credit balance.

Carol L. Bower
Instructor, Computerized Accounting
Empire College
Santa Rosa, California

Re: Numbering Revisited

Reading Ivan Strand's letter "Re: Numbering" [*PCW*, Vol 2., No. 7] was most interesting because I too have found *WordStar* inadequate for preparing documents with numbered paragraphs. However, rather than abandon an otherwise powerful word processing program, I wrote two utility programs to number and "unnumber" paragraphs in documents created by *WordStar*.

I am distributing these programs under the "user-supported software" concept and will release them to anyone who sends a formatted disk in a postage-prepaid return mailer to me at P.O. Box 8815, Boston, MA 02114. I request a $25 donation if the programs prove to be useful. Alternatively, for $25 up front I will supply the disk, the mailer, and postage.

Don Framback
Boston, Massachusetts

The One That Got Away

I enjoyed your October issue, but I hope your PC data is more accurate than your fish identification. The item about the Atlanta Boys Club annual bass tournament [*PC World View*, *PCW*, Vol. 2, No. 11] is illustrated with a picture of a trout.

Chuck Duke
Boston, Massachusetts

Already Here

Despite the closing paragraph of "Statistical Quintet" [*PCW*, Vol. 2, No. 10], your readers should be aware that *SPSS/PC*, the statistical analysis system from SPSS, is among the "excellent and affordable packages already available for the PC."

The first *SPSS/PC* system was shipped in July, too late for inclusion in your September issue. Please set the record straight—people don't have to wait for *SPSS/PC*.

Lucy Saunders
Marketing, SPSS Inc.
Chicago, Illinois

Star-Dot-Star Star

Thank you for printing the information about my graphics program, *PCPG* ["PC Picture Graphics," *.*, *PCW*, Vol. 2, No. 3]. I have been distributing *PCPG* as freeware, and it has generated a lot of interest. IBM is now distributing *PCPG* for me as one of its PC software products.

The enhanced *PCPG* distributed by IBM has a user manual on the disk with an on-line tu-

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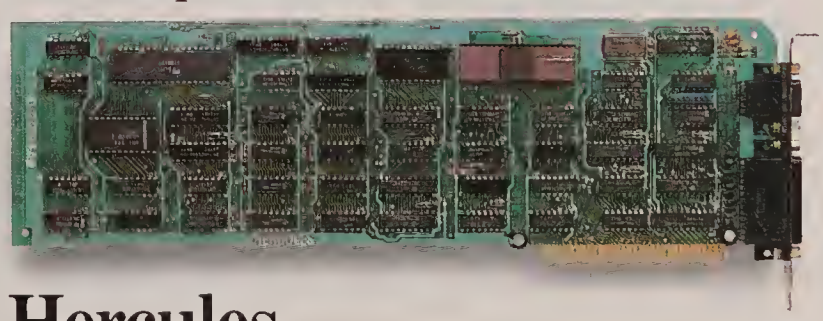

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Circle 59 on reader service card

torial and on-line help. It has an additional font (italic) and 60 more symbols. All the old symbols that were not closed (with painting leaking) are fixed. An automatic slide show is supported, users can create their own symbol library, and there are many other new features.

IBM is selling this new version at $29.95, the usual price of freeware or shareware. The enhanced *PCPG* will be sold at major computer stores and IBM product centers very soon or can be ordered now by calling, toll-free, 800/IBM-PCSW. Because of my contract with IBM, I don't distribute *PCPG* myself.

Eugene Ying
Kingsbridge Station, New York

Compiler Updates

I was very disappointed that in "Super BASIC" [*PCW*, Vol. 2, No. 10] Glenn Ouchi made no mention that IBM has never updated the BASIC compiler to support DOS 2.00 or 2.10 commands. I know many others besides myself who have written programs for IBM's BASCOM, only to be left hanging when it comes to path names and commands such as SHELL. I am very angry that IBM fails to support its languages. I am even angrier that my software will have to be rewritten in another language in order to perform functions that IBM supports in its BASIC interpreter but which may never be added to the compiler.

Michael J. Stone
New York, New York

In "Super BASIC" you indicate that the IBM PC BASIC compiler and the Microsoft BASIC compiler are slightly different. Slightly, indeed! If you don't need to use CLS, the function keys, and all of the commands related to the screen other than PRINT, I guess you can call the difference slight. But if you want to use all the power of the IBM version of BASIC, you had better use the IBM compiler.

You did a disservice to your readers by not including Microsoft's description of the differences in its compiler as a sidebar to the article.

Richard L. Budd
Beaver, Pennsylvania

It is a sad fact that IBM has not updated its compiler to include the powerful DOS 2.00 and 2.10 commands. I am sorry that I made no specific mention of this flaw.

Mr. Budd makes a good point: The differences between the Microsoft MS-DOS compiler and the IBM PC BASIC compiler were not emphasized. The Microsoft MS-DOS version is a "vanilla" compiler that contains no hardware-dependent commands. Thus, graphics, sound, and function keys are not utilized.–Glenn Ouchi

Letters should be mailed to Letters, PC World, *555 De Haro St., San Francisco, CA 94107, or sent electronically to MCI Mail PC-WORLD, CompuServe 74055,412, or The Source STE908. We reserve the right to edit letters. Letters should not exceed 300 words.*

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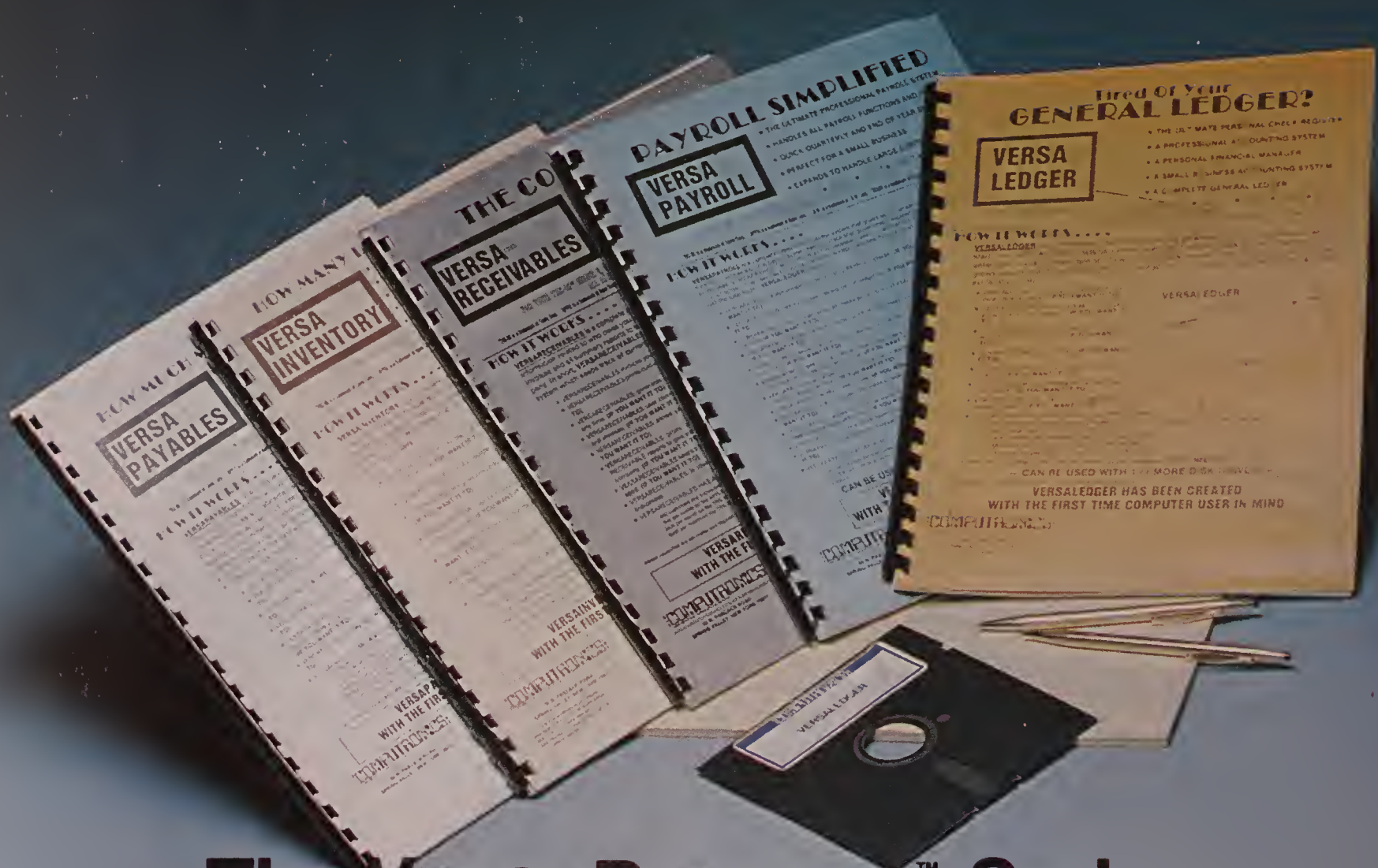

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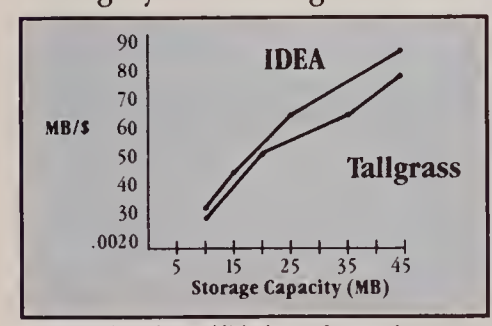

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PC WORLD

Microsoft Presses On

Microsoft Press, the publishing division of the Bellevue, Washington, software firm, may become the best-known name and logo in international computer book publishing. "The key for any consumer product is distribution," said M. Nahum Stiskin, Microsoft Press publisher and Microsoft Corporation vice president. The Microsoft Press International Publishing Consortium, scheduled at press time to debut at October's International Book Fair in Frankfurt, Germany, should assure him of the distribution he seeks.

M. Nahum Stiskin

The publishing consortium is made up of Simon & Schuster (the United States and Canada); Penguin Books (United Kingdom, Australia, and New Zealand); The Bertelsmann Publishing Group (Germany); Nathan Editeur (France); Mondadori Editore (Italy); Kluwer Group (the Netherlands); Tanum-Norli Forlaget (Norway); Liber Grafiska (Sweden); and ASCII Corporation (Japan). Each consortium member will publish the complete line of Microsoft books, with each volume carrying the dual imprint of Microsoft Press and the publisher. The precedent-setting agreement calls for consortium members to retain the format and style of the original books.

Stiskin is especially pleased at the inclusion of Mondadori, a publishing house known for its production and design standards. "No one tells Mondadori how to design a book," said Stiskin. He counts it as a coup that the Italian publisher agreed to use Microsoft Press's original design and art work.

Stiskin, who began looking for European distributors at the 1983 Frankfurt book fair, plans to bring other publishers into the fold. Within the next few months he expects to sign agreements with publishers in Spain, Portugal, Denmark, and perhaps Greece. "But what I'm really shooting for is China," he said.

PC World View *reports new developments in computer technology, items of interest to computer enthusiasts, and the most significant and enticing speculation about industry trends and personalities. We've reserved the "Grapevine" section of this column for industry reports that are still at the speculative stage.*
–Katie Seger

View

News and notes for the computing community

Politics Makes Strange Bedfellows

The use of personal computers in political campaigns increased 155 percent in 1984, according to a study conducted by Aristotle Industries. The company markets *Campaign Manager,* a leading microcomputer political software package. In 85 percent of the races tracked, the candidates with computers won their races. According to John Phillips, Aristotle Industries president, "Half a million people run for elected office every year."

Not all the political races studied ended in Washington; 1984 was the year that candidates for local offices–from county sheriff to school board member–discovered the Apple and the IBM PC.

Grapevine

As we go to press, the mystery surrounding the theft of a prototype PC AT from an IBM laboratory in Palm Beach County, Florida, has yet to be solved. News of the theft, which occurred last year during a weekend in May, was concealed even from the local sheriff's office and only came to light when a *Miami Herald* reporter received a tip.

An IBM spokesperson said that the company is continuing its "routine internal investigation" into the incident, but refused to give details. It's not surprising that IBM is publicly being tight-lipped about the theft, but it's probably a different story behind Entry Systems Division doors. Someone must have paid a great deal of money to get hold of the machine months before its formal announcement.

Big Blue's News

IBM's recent announcement of a local area network has overshadowed Big Blue's active pursuit of another branch of telecommunications—one that may change the way you buy software.

At a recent computer conference, Joyce Wrenn, director of software publishing for IBM's Entry Systems Division, dropped a few hints about the company's plans for software publishing and distribution. In addition to lauding the recent release of 31 business and productivity programs developed by IBM, Wrenn noted that IBM is looking hard at the idea of distributing its software to dealers by modem.

Although the concept of electronic software distribution is hardly new—retail computer stores and third-party marketers have toyed with the idea for several years—developing and distributing software for the PC is something of a departure for IBM. If nothing else, an electronic distribution system would show that IBM is getting aggressive with its software competitors—and may beat them to the software shelf.

The implications of an IBM electronic distribution network are staggering. All 1700 authorized PC dealers can currently be linked by modem to IBM's Customer Support System, which is served by an IBM mainframe computer located in Tampa, Florida. Dealers who subscribe to this service can get information about IBM products and receive technical assistance from IBM experts. With a software distribution network in place, dealers could receive the most up-to-date versions of IBM-written PC programs in very short order. IBM's grip on the software market could tighten further if the company extended the network to bookstores and software-only shops.

For dealers, the advantages of electronic distribution are obvious. There'd be no need to invest in expensive and rapidly outdated inventory; more important, no sales would be lost because programs were out-of-stock.

The potential to reach thousands of dealers instantly—and through them, hundreds of thousands of PC users—with IBM products is likely to etch permanent smiles on dealers' faces and strike fear into the hearts of independent software developers. The power of the IBM logo to move impressive amounts of merchandise, coupled with instant software availability and reduced inventory expense for the dealer, may well give IBM the imprimatur in the software market. The question is, will other major software publishers and distributors keep up and match IBM modem for modem?

* * * * * * * * * * * * * * * * * * *

Adding Up the Costs

IBM will outspend other computer companies in advertising this year, according to Schonfeld & Associates, a management consultant and mainframe software company based in Evanston, Illinois. The firm projects that IBM will spend $1.3 billion in 1985 for television, radio, print, and direct-mail advertising. Of course, not all that money will be spent plugging the PC family, but the advertising dollars are certain to keep Big Blue's name in the public eye.

Genetic Research

Dr. Robert H. Schwartz

Tracing your family tree is not the only application for genealogy research programs. Dr. Robert H. Schwartz, professor of pediatrics at the University of Rochester in Rochester, New York, has been using the *Family Roots* program from Quinsept for nearly two years in recombinant DNA research on cystic fibrosis. The fatal illness is one of the "most commonly inherited diseases in the United States," says Schwartz.

Schwartz, who is also director of the Cystic Fibrosis Care, Teaching, and Resource Center at the university's medical center, previously relied on standard genealogical flow charts to trace the inherited disease. Now he stores and organizes the personal, demographic, genealogic, and genetic records of approximately 850 people on his PC. Schwartz groups the subjects into "large kindreds"—families that descend from a common ancestral couple. One such kindred of 23 American and Canadian family groups descends from a husband and wife who lived in Alsace-Lorraine in the mid-1700s. Thirty-seven cases of cystic fibrosis have occurred in that kindred.

A Fair Exchange

The Securities and Exchange Commission (SEC) has initiated an electronic filing and retrieval system for publicly traded companies. The system, which debuted in September with 150 volunteer companies, is scheduled to run as a pilot program for approximately one year.

Called EDGAR—for electronic data gathering and retrieval—the system allows participating companies to file stock prospectuses, annual reports, tender offers, proxy statements, and similar information either by modem or by sending floppy disks. This information can then be accessed via IBM PC at SEC offices in Washington, D.C.; New York; and Chicago. For now, companies must also submit the electronically filed information the old-fashioned way—on paper. Approximately 1000 companies—including Citicorp, IBM, and Exxon—will be involved in the pilot program by March.

When the pilot program is completed, SEC officials plan to put the records of approximately 10,000 publicly held companies on line. However, personal computer users won't be able to connect their machines to the agency's files until March 1986.

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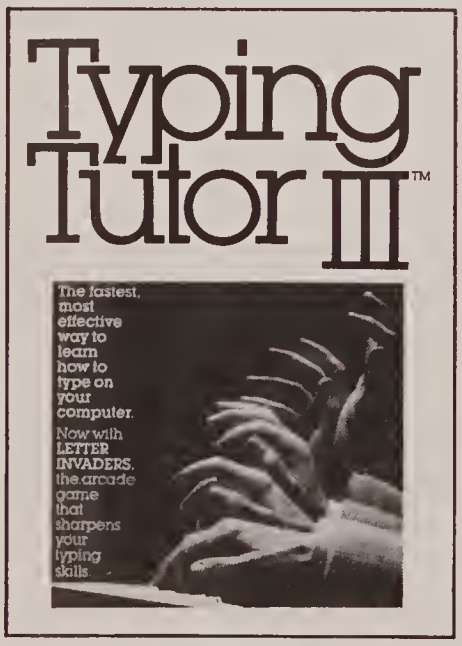

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Educational Discounts

The hefty prices charged for sophisticated word processing and spreadsheet programs often discourage their use in high school and college classrooms. Priced for business budgets, many programs are beyond the modest means of most school districts. But *PC World* correspondent Linda Williams discovered that help is at hand.

Recognizing that the programs students learn in school are probably the ones they'll buy after graduation, many software firms now offer substantial discounts—in some cases up to 78 percent off the retail price—to educational institutions. Most firms require school personnel to certify that the programs will be used by students in the classroom and not by teachers and administrators for school business.

Williams tracked down the single-unit, discount price of some popular PC programs: *EasyWriter I System* and *EasyWriter II System* from Information Unlimited Software, including mail merge and spelling checker programs, are available to schools for $50 each; Lifetree Software's *Volkswriter Deluxe* costs $65 per program; MicroPro's *WordStar* sells for $70; *SuperCalc 3*, from Sorcim, costs $37.50; and Lotus Development's *1-2-3* is offered to schools for $198. Other software firms offer similar discounts but had not yet determined prices at press time.

Microsoft sells *Word* and *Multiplan* at approximately 50 percent off the list price, but the company doesn't stipulate a classroom-use-only policy. In fact, Microsoft lets educational institutions resell programs to faculty and students for their own use. Since Microsoft's discount prices are steeper than those of other vendors, the company's policy is probably more attractive to universities, where more PCs are found on and off campus.

PC World View *welcomes contributions from readers, and we'll pay up to $50 for each item we use. Please include your name, address, and phone number with your contributions; send them to* PC World View, PC World, *555 De Haro St., San Francisco, CA 94107.*

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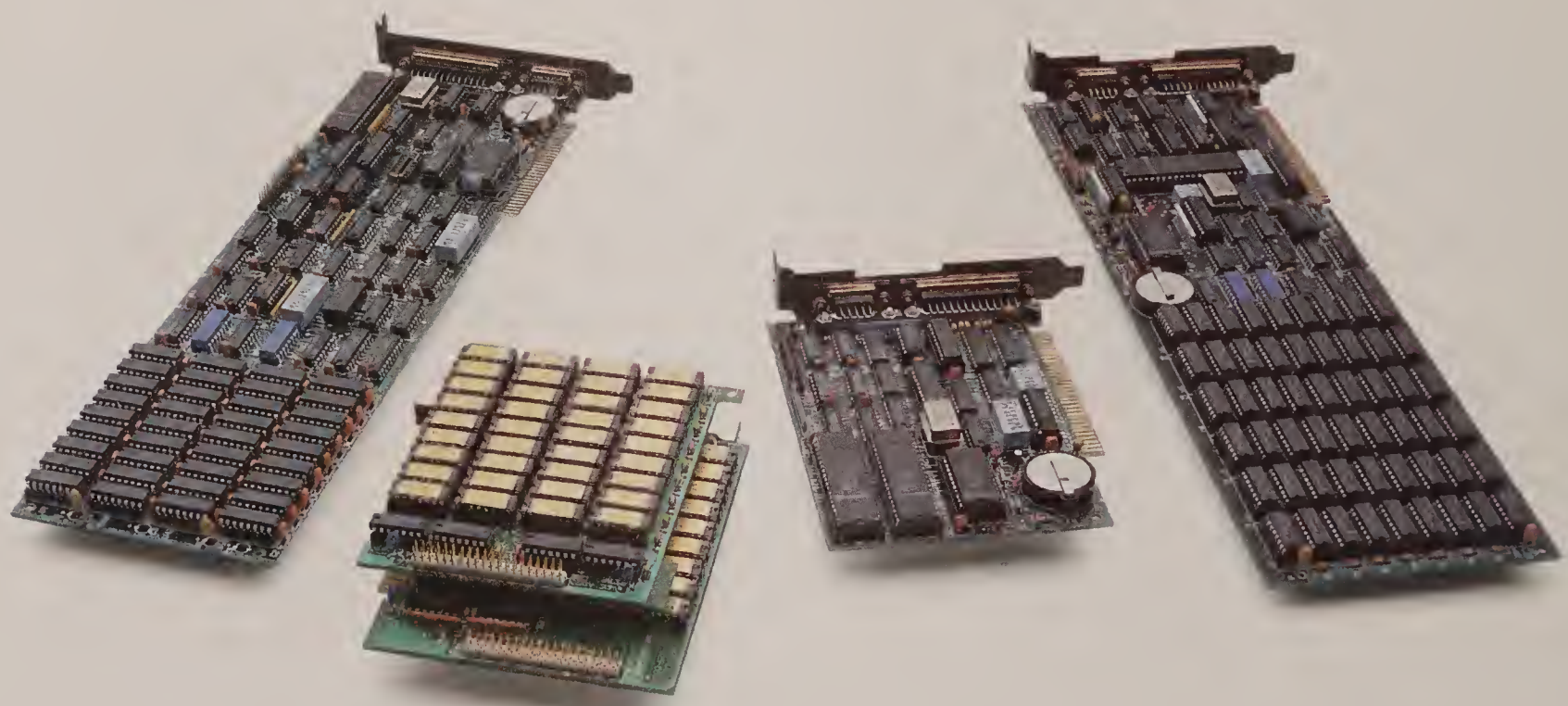

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The unique backplane of our IDEAmax 384 multifunction board allows you to cable interfaces directly from the back of the board. Our competitors make you thread cable through adjacent slots. This limits valuable space in your PC.

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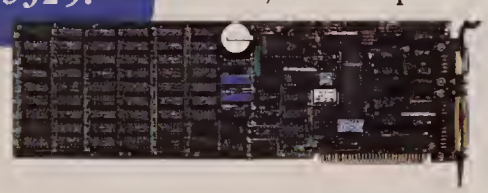

But, more importantly, why pay $50 to $200 more for our competitors' boards when the IDEAmax is only $325 at the same fine stores? And that price buys you 64K, parallel port, serial port and clock/calendar options. Plus, a game port and a total of 384K memory are also available with IDEAmax.

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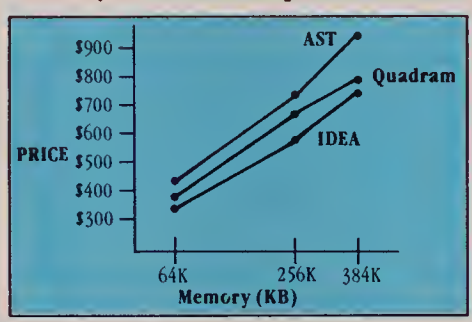

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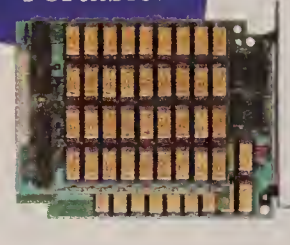

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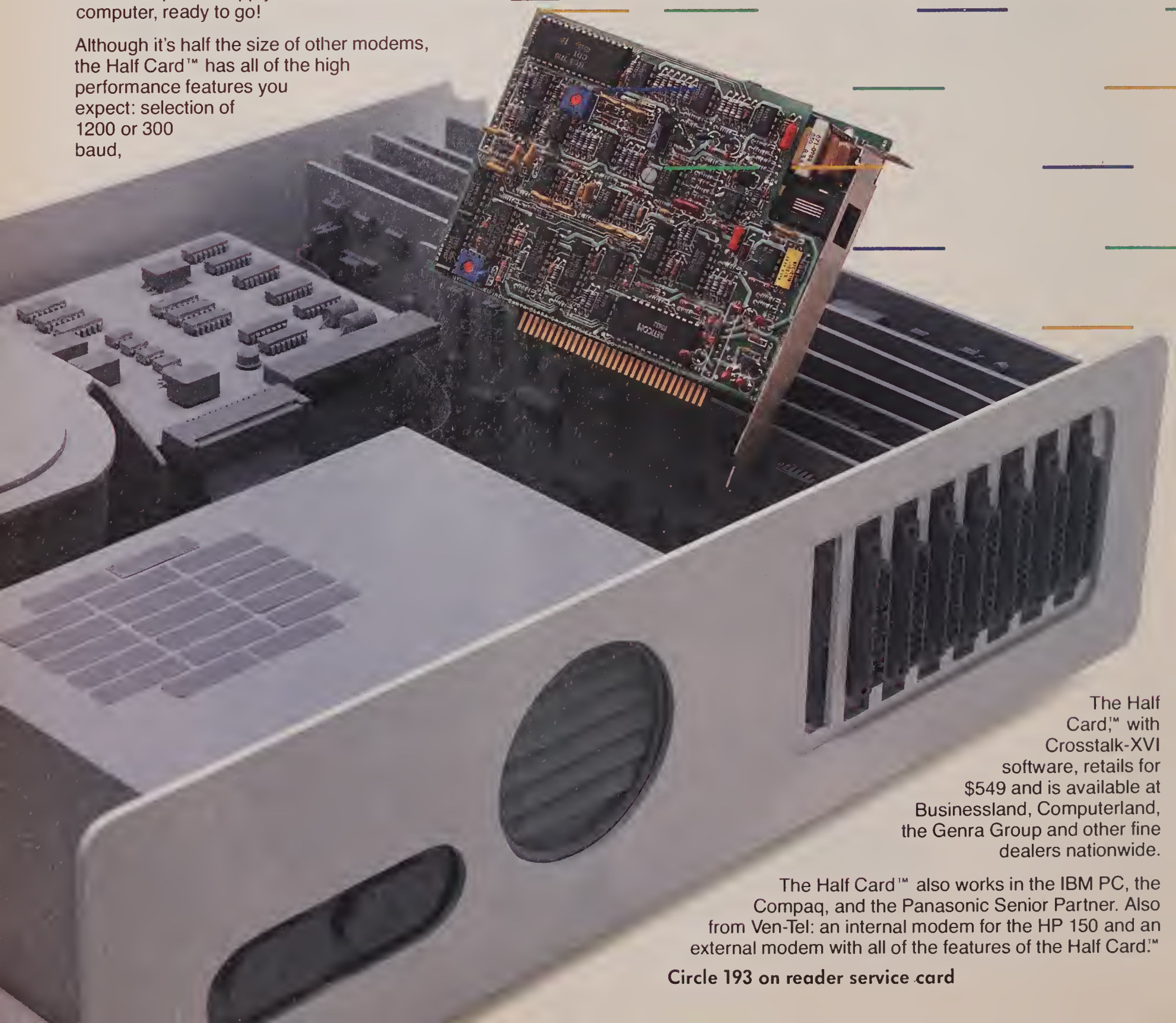

The Half Card,™ with Crosstalk-XVI software, retails for $549 and is available at Businessland, Computerland, the Genra Group and other fine dealers nationwide.

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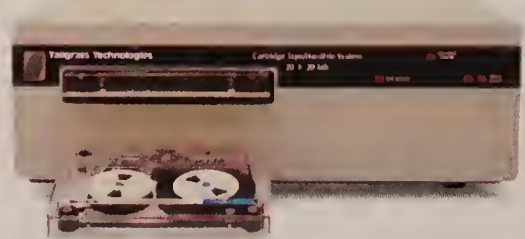

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Strategies for Sharing Resources

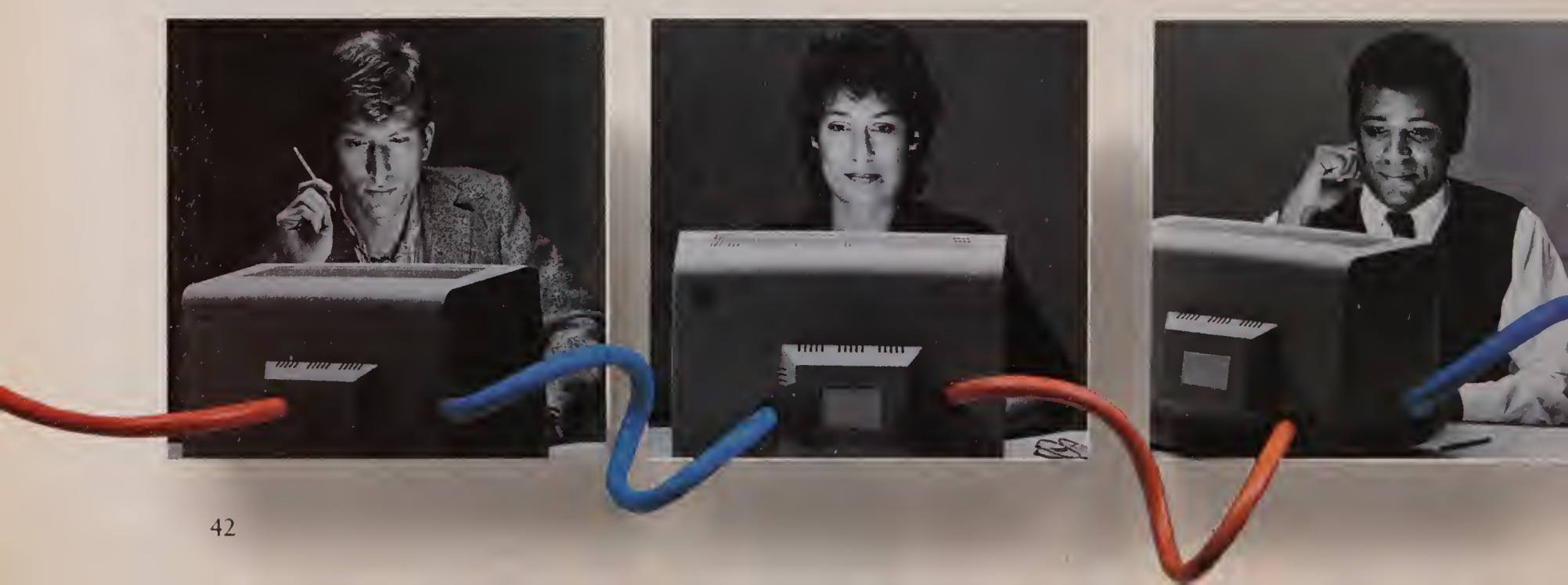
Your office has outgrown its first PC, and it's time to buy more hardware. You could buy a few more stand-alone PCs, but with a little research you may discover more efficient ways of handling office information. Linking several PCs on a local area network or buying a multiuser computer with several terminals may be the best way to get the most from your hardware and data.

Michael K. Guttman

When an office first acquires a PC, the machine's capacities seem almost unlimited. Gradually, however, it begins to seem that one PC is not enough. The next step is usually to purchase more PCs.

First each department gets one, then PCs start multiplying within departments. New complications arise: each PC requires its own peripherals and software. In order to share data among users of different computers, disks must be carried from machine to machine, multiplying the headaches of keeping track of copies and backing up data.

Sooner or later it becomes clear that there must be a better way to handle data and computing resources within an office. There is. More and more offices are turning toward alternatives that allow several users at once to share data and peripherals. The two alternatives are multiuser systems and local area networks (LANs).



The Next Step

According to Future Computing, a market research firm specializing in the personal computing marketplace, shipments of personal computer LANs will increase from 10,000 in 1983 to 166,000 in 1988. Although the multiuser market is not projected to grow as fast as the LAN market, multiuser sales are expected to double in the next five years.

LANs allow individual users to pursue tasks independently from separate PCs while calling on shared resources, such as hard disks, high-speed printers, and shared data bases (see "Local Area Networks," *PCW,* Vol. 2, No. 7, for an introduction to LANs). Networks have been used for some time to link large computers.

In general, a multiuser system ties users together more closely than a LAN. Each user may pursue tasks independently, but it is more likely that users will be engaged in tasks that involve intensive sharing of common data.

Bus Routes

If an office has already acquired several PCs, the best way to share resources may be a LAN. Unlike multiuser systems, LANs can usually use PCs as work stations, or *nodes* in LAN terminology. Theoretically some LANs can support hundreds of PCs, but all the machines must usually be in a fairly small area, such as a single building.

Several different *topologies,* or geometric layouts, are used for LANs. The most common are *star, ring,* and *bus* networks (see Figure 1). Most net-

works depend on *file servers*, which are central computers responsible for managing the transfer of data between the computers. The file server usually contains hard disk storage for common files and manages access to shared peripherals. In a star network each PC is hooked directly to a central file server. In a ring network each PC is hooked to the next, creating a circle. In a bus network the PCs are strung along a central bus, or cable, which is connected to a file server. Each topology has advantages and disadvantages (see "Untangling Networks" in this issue for a discussion of the benefits of different LAN configurations).

The topology of a multiuser system is generally referred to as its *system architecture* (see Figure 2). The most straightforward form is single-processor architecture. This configuration assigns all system functions to a single multitasking processor unit. The central system unit usually contains a hard disk and interfaces for printers, modems, and other peripherals. The processor shares its time among terminals, usually giving each in turn a small time slice (perhaps a fraction of a second) on a first in, first out basis. In a multiuser system the central processing unit and terminals are usually designed especially for the system. Each multiuser system requires its own proprietary hardware.

Single-processor architecture offers tight control of system resources, but it has the disadvantage of bogging down dramatically as system activity increases. When several users are on the system, the central processor spends more time shuttling around users' requests than processing them. To remedy the problem, multiprocessor multiuser systems have been developed, in which the processing load is shared among a constellation of processors.

In a multiprocessor environment tight resource control is maintained, but the central processor, a multitasking chip like the Intel 80186 or 80286, delegates portions of a task to single-tasking "slave" processors for execution. Multiprocessing systems are more expensive than single-processor systems, but their performance is considerably faster (see "The Multiuser Dimension" in this issue for a review of North Star Computers' multiprocessor system, the Dimension).

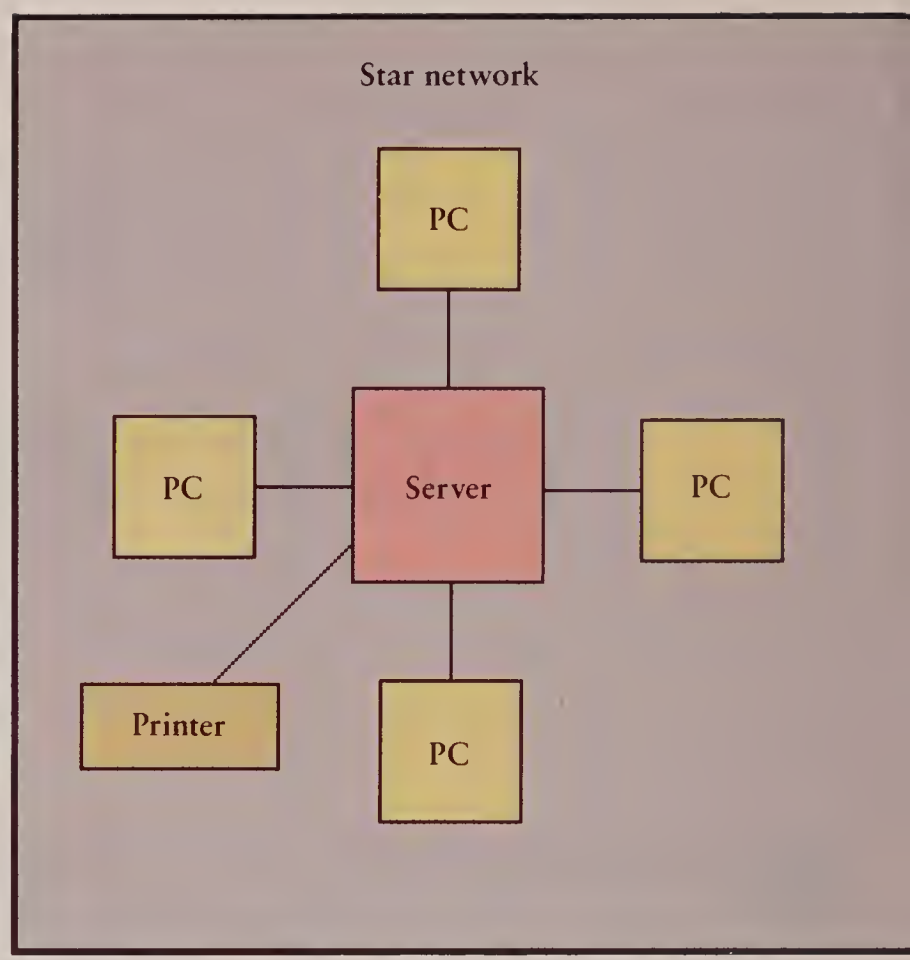


Figure 1: Networks are usually organized into star, ring, or bus topologies. Networks usually depend on a central file server that controls the distri-

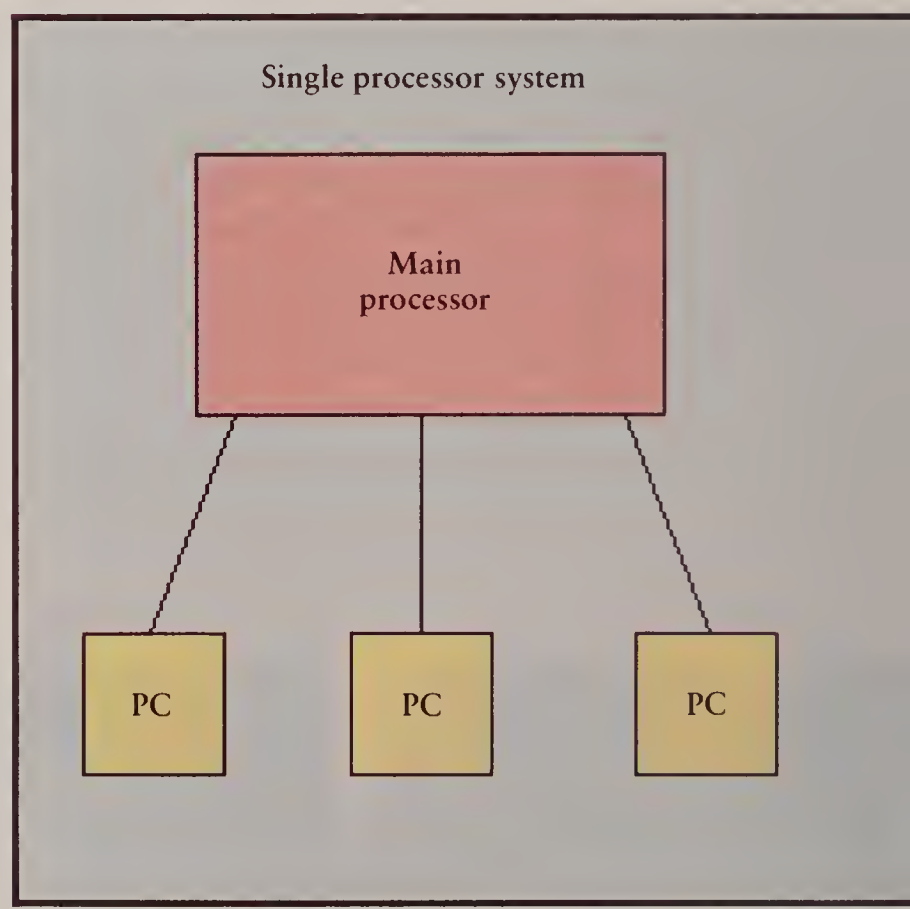
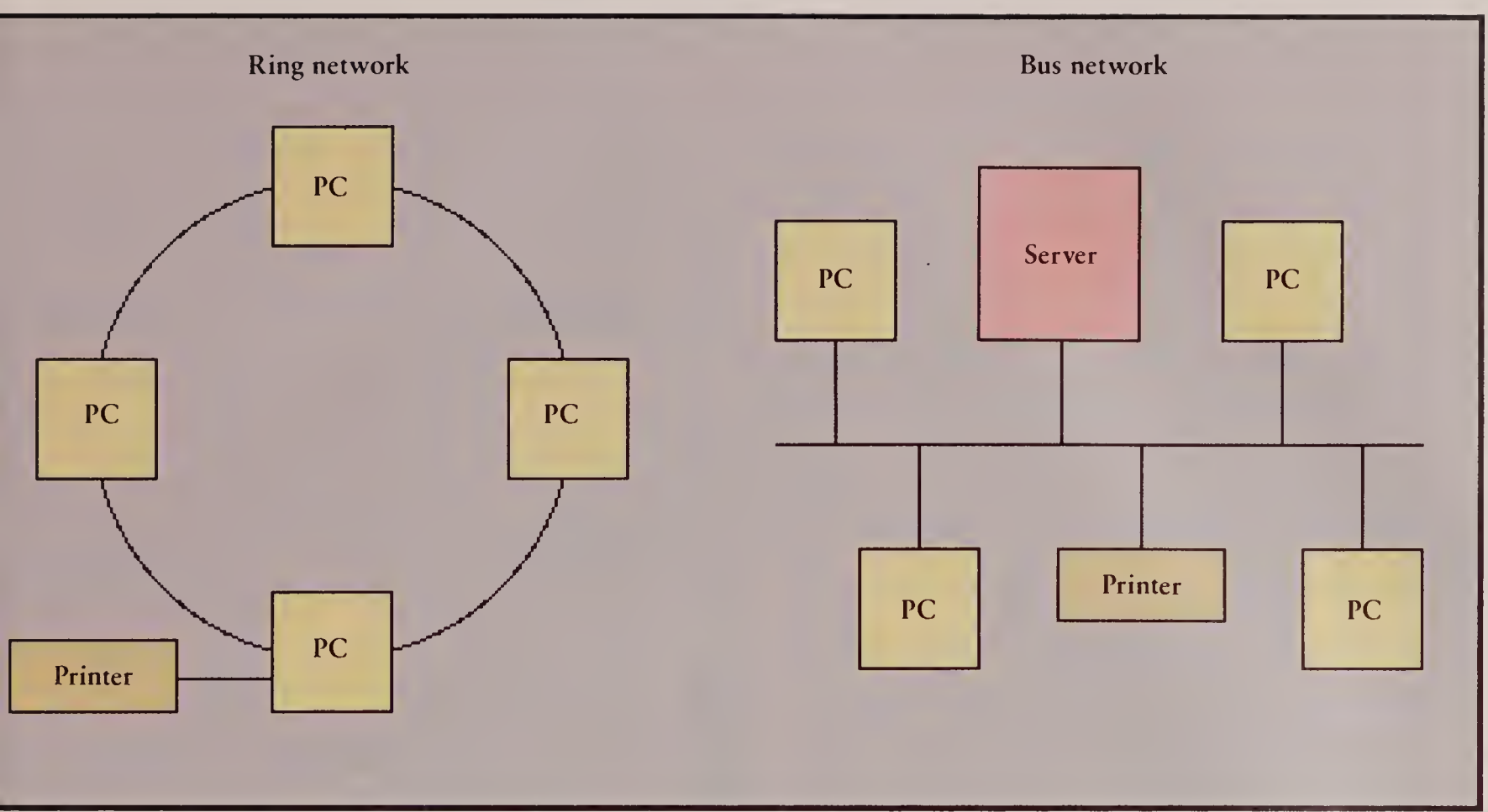
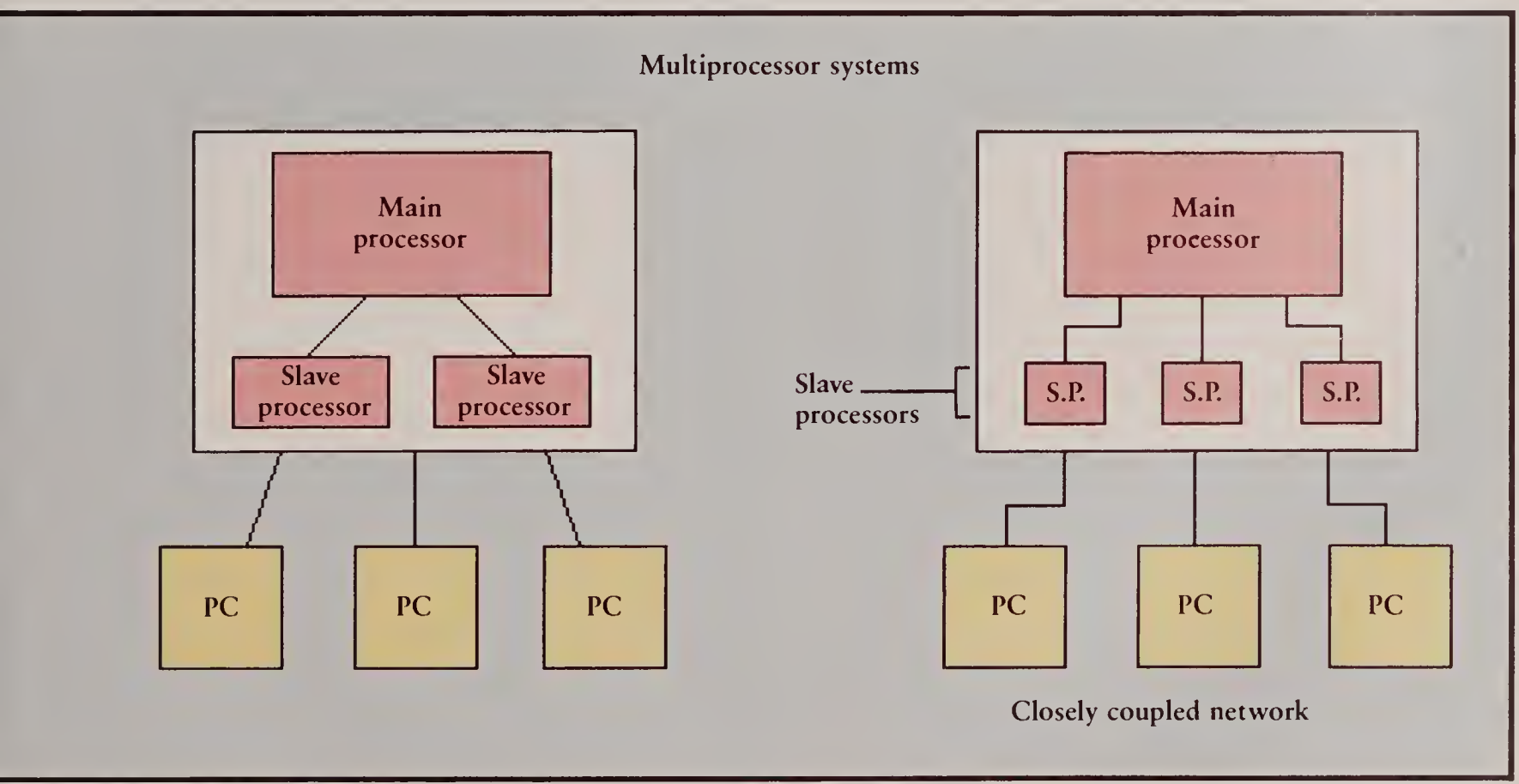


Figure 2: Multiuser systems are divided into single-processor and multiprocessor systems. In a multiprocessor system the main processor delegates tasks to slave processors to keep system per-



bution and storage of data. Any PC on the network can use any peripheral or the files from any disk drive.



formance high. In some multiprocessor systems each terminal has its own multipurpose processor in the main processing unit. This type of multiuser system, sometimes called a closely coupled network, is much like a LAN, except that each work station's processor is in the main cabinet instead of within the work station.

In one variant of multiprocessor architecture called *distributed processing*, the central processor assigns each processing task to a slave processor. The central processor is freed to carry out other tasks, such as handling access to the hard disk or another shared peripheral. In one form of distributed processing, each slave board is a nearly complete PC, with each board exercising control over the user interface and all local peripherals for a terminal. This form so nearly resembles a star network that it is sometimes referred to as a *closely coupled network*.

Weighing Alternatives

The choice between a LAN and a multiuser system depends largely on how much hardware you have already acquired and on how many work stations your office requires. Hardware purchases are often initially haphazard; before someone realizes the benefits of sharing resources, PCs may be purchased independently by different individuals or departments with substantial duplication of hardware, software, and peripherals. If your office already has a substantial number of PCs, the clear choice for resource sharing is a local area network, which can integrate existing hardware.

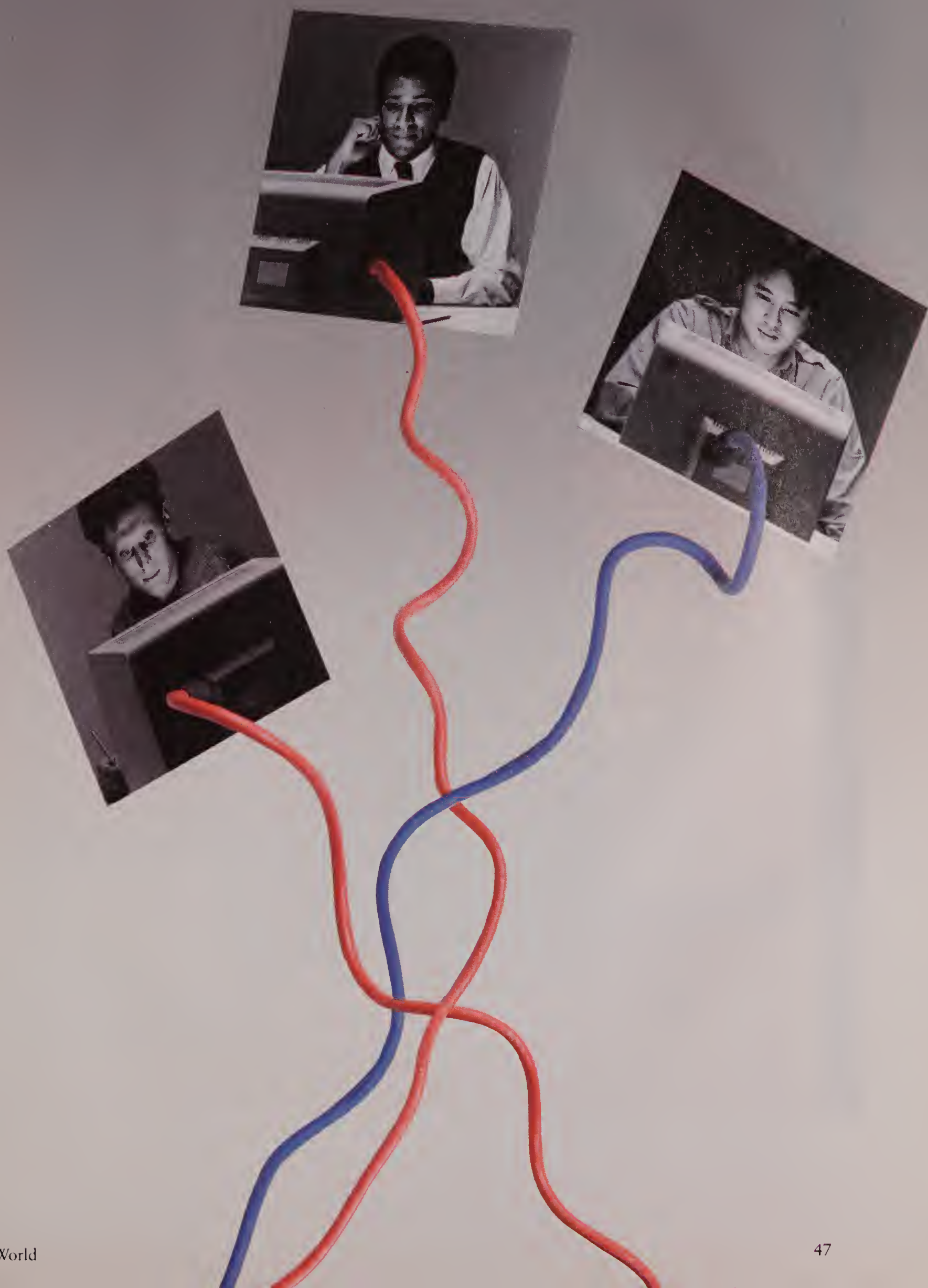
If an office wants to share data among only a few work stations and doesn't need to incorporate a lot of existing hardware, a multiuser system might be the better solution (see "Multiuser Systems" for a list of some available hardware). Implementation and add-on costs for a multiuser system are usually much less than for a LAN, because each multiuser work station is an inexpensive dumb terminal rather than a complete computer plus network board. An eight-station LAN could easily cost over $30,000, or about $4000 per work station. A network board is generally required for each PC at a cost of $500 to $1000 per board. The company must also purchase a file server ($10,000 to $15,000) and network software ($500 to $2500). In addition, the office may have to be rewired and rearranged to accommodate the network's physical requirements, and new application software, designed for use on a network, must be acquired. An eight-station multiuser system would probably cost about $16,000, or $2000 per work station. The incremental cost for each additional LAN work station might be $3000, while an additional multiuser system work station might be $1500.

However, if you need a system with many work stations, a LAN may be your only alternative. While many LANs provide support, albeit limited support, to one hundred or more work stations, a typical micro-based multiuser system can accommodate only about a dozen terminals.

Several other differences between LANs and multiuser systems should be considered before you choose a data-sharing strategy. One problem with LANs that has only recently been addressed is the handling of data requests by several users. If off-the-shelf software is used on a LAN, the danger exists of multiple users trying to update the same file simultaneously (the so-called "deadly embrace"). Special LAN software that provides *file locking* and *record locking* to prevent this problem has only recently been developed. In a multiuser system these problems are usually managed by the operating system, but LANs are more loosely controlled. Since LANs lack a central controlling processor, file handling cannot be taken care of by the operating system alone.

If an office wants to share data among only a few work stations and doesn't need to incorporate a lot of existing hardware, a multiuser system might be the better solution.

Data transfer rates within a multiuser system are generally faster than those within a LAN. In a LAN, data must be serially transferred down a cable to each PC for processing, while multiuser system processing takes place entirely within the central unit under the control of the central processor. In fact, the data often doesn't need to be "transferred" at all. This means that LAN operation may be too slow for applications that require frequent access to data, and a multiuser system would be a better data-sharing strategy for tasks that depend on those applications.



Multiuser Systems

The list below represents a sampling of available multiuser computers. These computers vary widely in their capacities and configurations. Multiprocessor systems generally give faster performance than single-processor systems, especially when a number of people are using the system simultaneously. Most multiprocessor computers use an integrated processor like the Intel 80186 or 80286 to oversee multiple tasks, assigning tasks to single-tasking "slave" processors. Some assign the tasks for each work station to a separate slave processor, while others distribute portions of each task to a few microprocessors. More information about the capabilities of each of these systems can be obtained by calling the numbers listed. Terminals are generally not included in the quoted list price.

Single-Processor Systems

IBM PC AT
IBM
Entry Systems Division
P.O. Box 1328
Boca Raton, FL 33432
For up to 4 users
800/447-4700, 800/447-0890 Alaska and Hawaii, 800/322-4400 Illinois
List price: Model 68 (256K, one 1.2MB floppy disk drive) $3995; Model 99 (512K, one 1.2MB floppy disk drive, combination serial and parallel board, 20MB hard disk) $5795

Poppy 186
Durango Systems Inc.
3003 N. First St.
San Jose, CA 95134
408/946-5000
For up to 4 users
List price: with 128K, one 819K floppy disk drive, 10MB hard disk, two serial ports, one parallel port, Concurrent CP/M-86 $3345

SuperMicro
Rair Microcomputer Corp.
4101 Burton Dr.
Santa Clara, CA 95050
408/988-1790
For up to 16 users
List price: with 512K (expandable to 2MB), floppy disk drive, 50MB hard disk, 45MB streaming tape drive, eight serial ports, 80287 coprocessor $15,500

Visual 2000
Visual Technology Inc.
540 Main St.
Tewksbury, MA 08176
617/851-5000
For up to 16 users
List price: with 512K, 800K floppy disk drive, 19MB hard disk, one parallel and six serial ports $8990; 45MB streaming tape drive $2795

420, 440, 460
Stride Computers
4905 Energy Way
Reno, NV 89509
702/322-6868
For up to 16 users
List price: 420 with 256K RAM, two 800K floppy disk drives, one parallel port, four serial ports (four users) $2900; 440 with one 800K floppy disk drive, 10MB hard disk, ten serial ports (ten users), one parallel port $5900; 460 with 256K RAM, one 800K floppy disk drive, 15MB hard disk, ten serial ports (ten users), one parallel port $8900

Multiprocessor Systems

Corona Mega PC
Corona Data Systems
3134 Via Colinas #110
Westlake Village, CA 91361
213/707-0672
For up to 8 users
List price: with two terminals, 256K RAM per user, 10MB hard disk $7805; each additional user $1495; 43MB streaming tape drive $1995

TeleVideo Personal Mini
TeleVideo Systems, Inc.
550 E. Brokaw Rd.
San Jose, CA 95112
800/971-0255, 800/821-3774 California
For up to 8 users
List price: with 43MB hard disk, 767K floppy disk drive, the InfoShare operating system $8995

Compupro 10 Plus
Compupro
3506 Breakwater Ct.
Hayward, CA 94545
415/786-0909
For up to 4 users
List price: with 1MB RAM, two 800K floppy disk drives, seven serial ports, one parallel port, Concurrent CP/M-816 $4995

Compupro 286
Compupro
For up to 5 users
List price: with 512K RAM (expandable to 16MB), one 800K floppy disk drive, a 40MB hard disk, five serial ports, one printer port, one parallel port, Concurrent DOS-816 $9995

Poppy 286
Durango Systems Inc.
3003 N. First St.
San Jose, CA 95134
408/946-5000
For up to 12 users
List price: with 512K RAM, 1.2MB floppy disk drive, 20MB hard disk, two serial ports, one parallel port $6995

But multiuser systems are not without their problems. Thus far no single multiuser manufacturer has managed to create a de facto standard in the marketplace. None of the industry leaders, including IBM, has yet marketed a micro-based multiuser product. Since MS-DOS was designed for use with the 8088 single-user processor, until quite recently no multiuser systems ran the MS-DOS software that made the IBM PC and its compatibles so popular.

Because of this gap, most micro-based multiuser systems have been designed to run multiuser operating systems such as Digital Research's MP/M (the big brother of CP/M), Bell Labs' UNIX, and their various imitators. IBM is now apparently marching under the UNIX banner, having released a version of Microsoft's Xenix for the PC AT. In the absence of an obvious standard, each manufacturer's system tends to be unique. Even systems that claim to follow UNIX or MP/M are not always 100 percent compatible, largely because of the understandable temptation for manufacturers to offer attractive, but nonstandard, enhancements to their systems.

Probably the most serious difficulty with multiuser systems is that the failure of a single component in the central processor can bring all users to a halt, while users on a LAN could continue local tasks without great inconvenience. Of course, in star networks or any LANs in which the majority of work requires access to a central data base, failure of the central file server can cause much the same problem.

Market Trends, Future Systems

The problems with both LANs and multiuser systems have not gone unnoticed. New multiuser systems that support DOS software, along with improved LAN technology and software, are erasing the file-handling problems that have troubled the market.

Products attempting to fill the MS-DOS support gap for multiuser systems can be divided into two basic groups. The first group offers a multiuser computer with a custom operating system designed to run MS-DOS software. North Star Computers, Tele-Video Systems, and Corona Data Systems are now offering products that run MS-DOS software in a multiuser environment. The second group runs a version of DOS under a multiuser operating system such as MP/M or UNIX. Industry analysts predict that the future of the multiuser market lies in the development of machines that can run any number of operating systems concurrently and independently underneath a machine-dependent BIOS (Basic Input/Output System). This admirable goal may be closer than one might expect. For example, Stride (formerly Sage) Computers of Reno, Nevada, already offers a line of multiuser computers that the company claims can run 14 different operating systems concurrently if enough memory is provided.

At the same time, LAN technology is improving. We can expect the eventual introduction of less expensive LANs that mimic the data transfer rates and process control functions of multiuser systems.

Ultimately, LANs and multiuser systems will each find a place in the market, probably in configurations that include both types of systems. Multiuser systems are best for small clusters of users that share common data, such as single departments. LANs, on the other hand, can provide communication between multiuser system clusters. And at a higher level, telecommunications networks could connect corporate LANs around the world.

Many microcomputer manufacturers are already anticipating this blending of multiuser systems and LANs. Compupro, a long-time manufacturer of MP/M multiuser systems, has introduced a networking system that provides the performance of a multiuser system and also gives access to an extended network of up to 255 multiuser system clusters. This approach, already in heavy use for mini/mainframe connections, may well mark the future for microcomputing as well.

Michael K. Guttman is a general partner in Professional Computer Technologies, a consulting and software development company in Chico, California.

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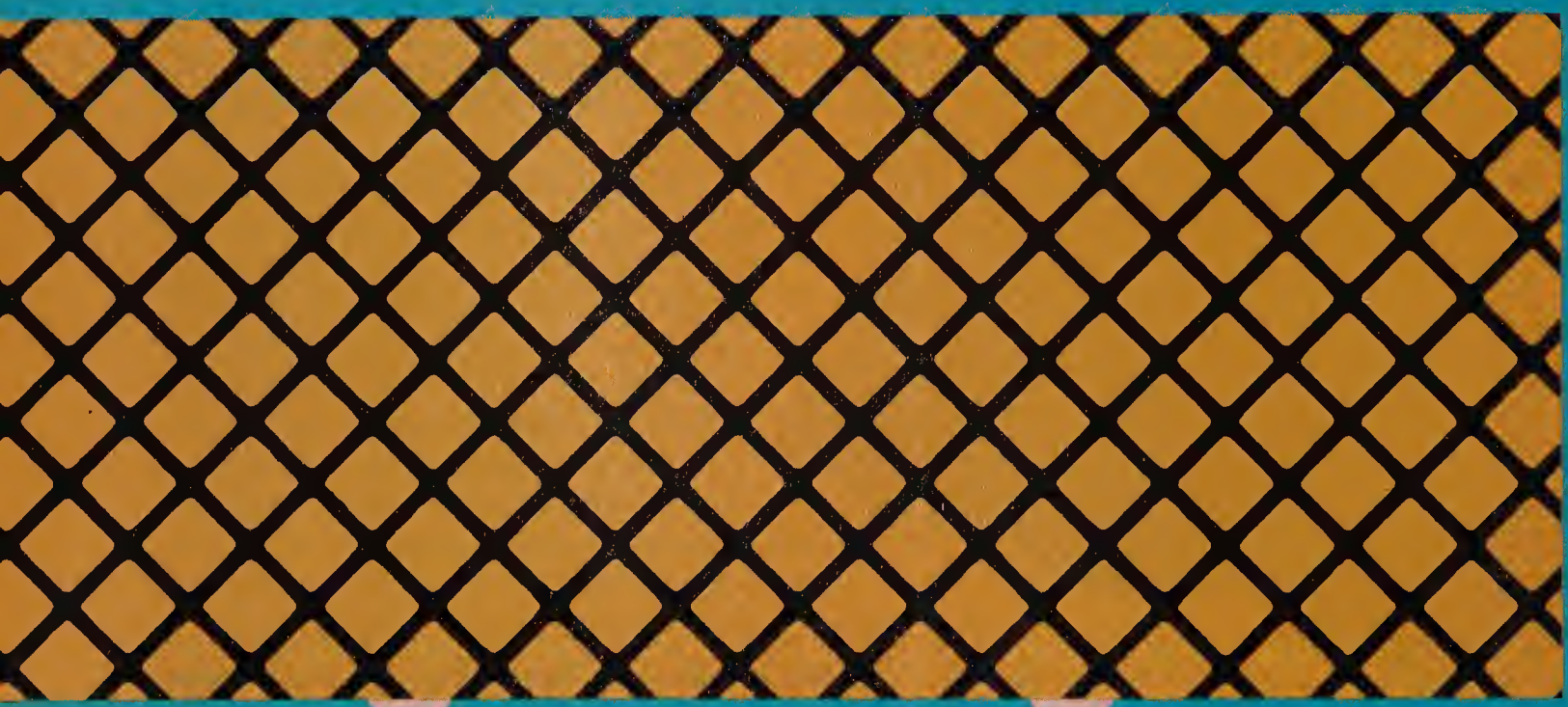

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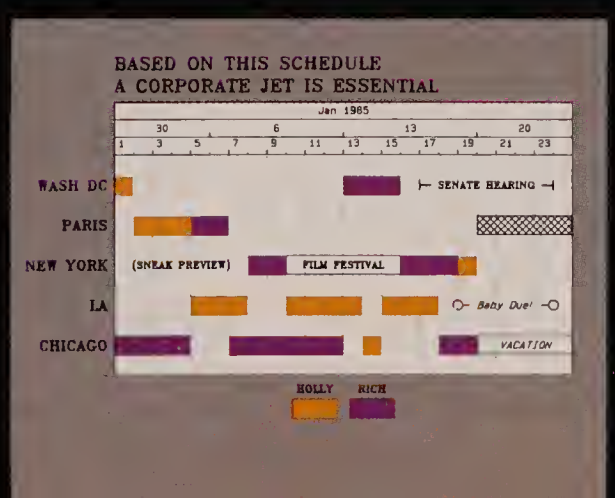

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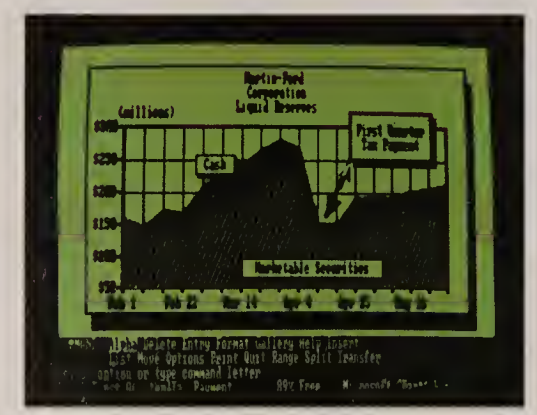

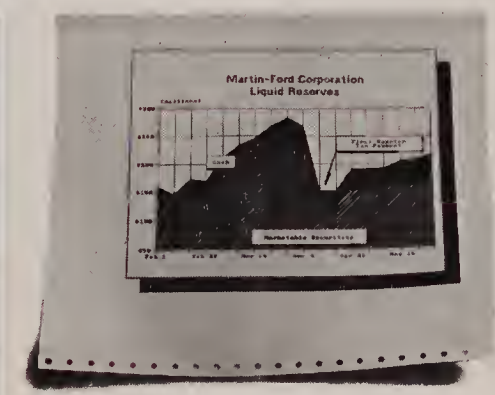

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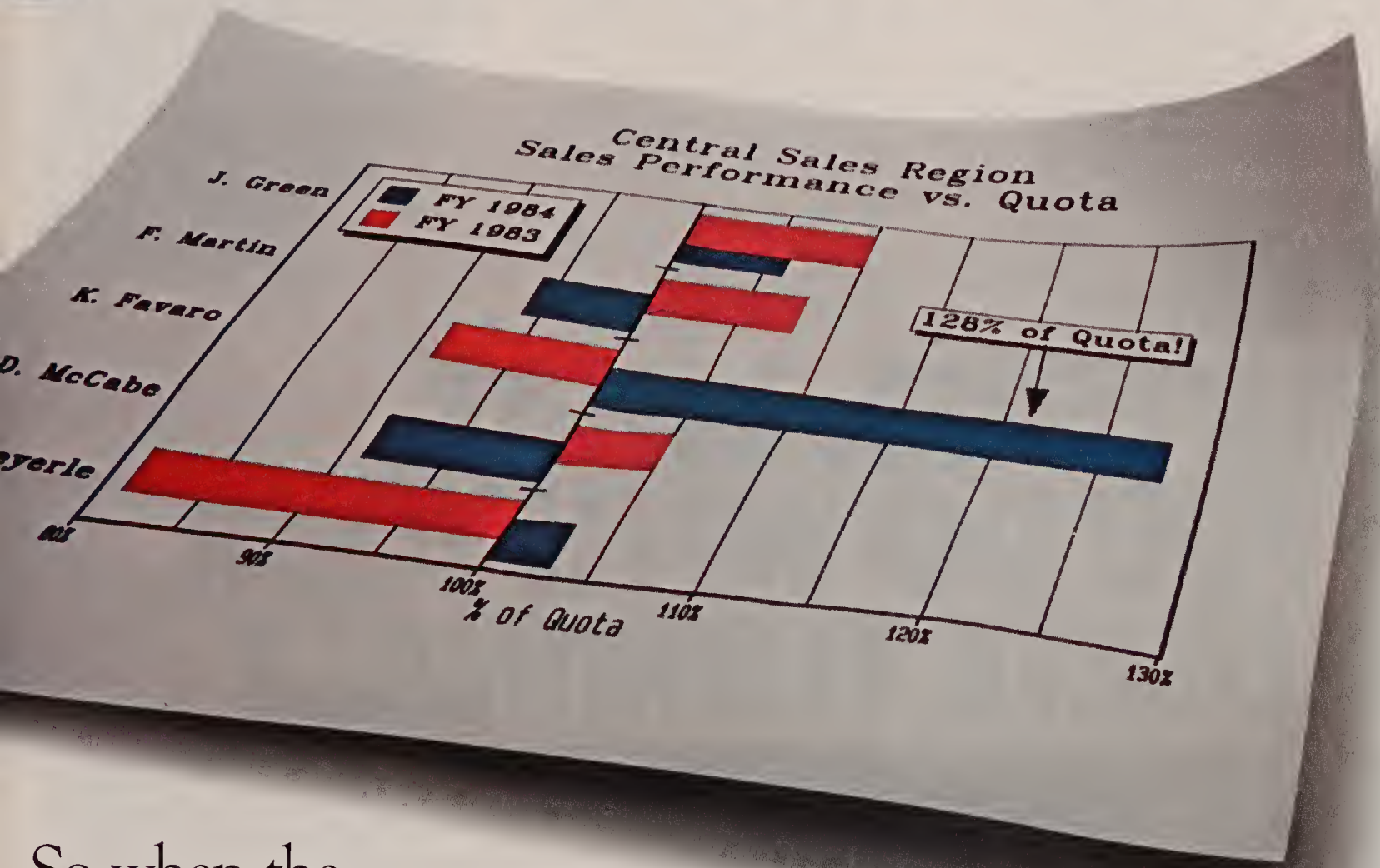

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When the PC was introduced, critics asked what users would do with more memory than could be recorded on a floppy disk. One of the first and most versatile uses of "excess" RAM is the emulation of disk drives.

Karl Koessel

An Introduction to RAM Disks

Q. In Raymond DeMers' October "Hands On" article, "The Single-Button Menu" [PCW, Vol. 2, No. 11], he tells us to make a RAM disk. What is a RAM disk? How do you prepare them and what do they do? Also, how are they used in programming? Obviously I am a novice, but the IBM manuals do not mention RAM disks.

Wayne M. Harris
La Jolla, California

A. RAM disks are known by many names: emulated disks, memory disks, electronic disks, E-disks, pseudodisks, hyperdisks, V-disks, virtual disks, and logical disks. (The terms "logical disk" and "virtual disk" also have other meanings.) A RAM disk is a portion of the computer's RAM (also called user memory—the random access memory chips inside the PC to which a program and data are loaded) that can be used as if it were a disk drive. Like a floppy or hard disk drive, a RAM disk drive is referenced by a drive designator (a letter followed by a colon), and files are written to and read from it. For example, if the RAM drive is drive D:, the DOS command DIR D: displays the directory of the files in the RAM drive.

RAM that is set aside for use as a RAM disk is no longer available for any other use (until the PC is reset). But because a large amount of RAM can be installed in the PC, utilizing part of RAM as a RAM disk is quite popular.

Because a RAM disk has no moving parts, it performs disk operations (which consist mostly of reading and writing data) nearly 50 times faster than a floppy disk drive and about 10 times faster than a typical hard disk. In addition to providing greater speed, a RAM disk prolongs the life of floppy disks and floppy disk drives by reducing their use. But these advantages are not free. Because a RAM disk stores its data in the PC's electronic memory, any files you want to save for later use must be copied onto a physical (floppy or hard) disk. If the computer becomes inoperative due to a system error or a power problem before you save your files, the contents of the RAM disk are lost.

You can provide some measure of insurance against these problems by equipping your PC with a battery-operated backup power supply and by keeping only copies of programs (not data files) in the RAM disk. Each of these forms of insurance has its drawbacks, however.

Backups that "kick in" fast enough to prevent the PC from resetting itself due to a power interruption are expensive. In addition, if the PC has become inoperative due to a system error rather than a loss of power, backup power is of no use. In such cases, RAM files generally cannot be copied. (*JFormat,* from Tall Tree Systems, includes a RAM disk with other utilities that enable you to reboot the PC and preserve the contents of the RAM disk.)

Restricting the RAM disk to storage of programs, not data, defeats a primary purpose of RAM drives: to maximize the speed at which data is manipulated, particularly by such "disk-intensive" applications as data base managers.

But there's a third form of insurance against losing the data held in RAM disk files—a macro

processor such as *SmartKey,* from Software Research Technologies, or *ProKey,* from RoseSoft. Although a macro processor requires that you define the steps necessary to copy RAM disk files (which is not as difficult as it sounds–see "The WordStar WIP File," *.*, *PCW,* Vol. 1, No. 4), a single keystroke or key combination will copy data files in the RAM disk to a physical drive. This approach can't, of course, anticipate (or recover data lost during) power problems, but it can make saving RAM disk files second nature.

(*PCW,* Vol. 1, No. 1, includes two articles on macro processors: "The PC in a New Key" and "ProKey Chimes In." Both mention *Keynote,* a macro processor that is no longer available, but the articles are good introductions to macro processors. "Macro Mastery," *PCW,* Vol. 2, No. 1, explores the potential of *ProKey,* whose excellent features make it one of the most powerful macro processors.)

Software for creating RAM disks is available from over 20 sources, including some in the public domain. Such software is included free–along with other "RAM-resident" utilities, such as print spoolers–with almost every third-party memory expansion board. (These utilities are usually available from manufacturers for a low price if you don't want to buy a memory board.)

IBM published a RAM disk assembly language listing (which requires an assembler to implement) as a sample "installable device driver," a new feature for DOS 2.00 (also supported by later versions) in Chapter 14 of the DOS 2.00 manual and in Chapter 3 of the pink DOS 2.10 Technical Reference manual (not to be confused with the indigo Technical Reference manual). IBM now markets *Memory Options,* a disk of utilities for the PCjr that includes a RAM disk device driver in a file called RAMDISK.COM. The DOS 3.00 system disk also has a RAM disk device driver, called VDISK.SYS. VDISK can be installed on any member of the PC family that has sufficient memory and is running DOS 2.00 or a later version.

RAM disk software comes in two forms: as a device driver or as a DOS program. RAM disk programs that are device drivers require DOS 2.00 or a later version for installation; those that are DOS programs usually work only with a specific (earlier) version of DOS. A DOS program RAM disk is implemented by entering the program name–usually followed by parameters specifying various features (see details following)–at the DOS prompt from either the keyboard or a batch file.

A device driver RAM disk is installed by including the following line in a text file called CONFIG.SYS on the DOS disk with which you start up your PC:

DEVICE = *filename* [*option(s)*]

Filename is the name of the device driver file; *option(s)* indicates the desired available feature(s), such as the drive letter and the size of the RAM disk. The start-up disk must also contain a copy of the device driver file. (More specific instructions for installing a RAM disk device are included with each manufacturer's driver.)

The features provided by RAM disk software vary among manufacturers. Some programs allow you to specify the RAM disk's drive designator, while others automatically name the drive with the next available drive letter. Some programs require you to reset the PC's system switches (which are inside the system unit) to indicate the additional RAM drive(s). Some allow you to assign the RAM drive only a specific drive letter (for example, C:) or a small range of drive letters (such as B: through D:, or A: through F:), while others allow you to use any letter of the alphabet. Some programs allow you to assign a drive letter belonging to an existing physical drive, enabling you to use a RAM drive with those (poorly programmed) applications that can write only to a specific drive. For the same reason, some programs allow you to assign a drive letter and specify that the RAM drive is to be inserted. For example, if your system has phys-

ical drives A:, B:, and C:, and you insert a RAM drive B:, the physical drives B: and C: will be redesignated as C: and D:. Some RAM disk software can create only one RAM drive, while other programs can create as many RAM drives as the number of drive letters they can recognize.

Some programs can create only drives of a fixed size (such as 180K or 360K), but most permit you to designate the size of the RAM drive or the amount of memory that is to be left free after the drive has been installed. Given these options, you can use available memory as you see fit. Some programs permit you to designate the size of the RAM disk in increments of 1K, while others inconveniently require you to designate the size as a factor of some larger increment (for example, you might have to specify a size of "10" for a 320K RAM drive). Most limit the maximum size to 320K or 360K; however, some can create larger RAM disks (up to 2½ megabytes) if your system has enough RAM.

Besides reducing the time required by disk-intensive operations, RAM disks can facilitate the use of subdirectories with applications that do not recognize subdirectory paths. Many hard disk users, accustomed to a favorite word processor written before the implementation of subdirectories, have copied their word processor into each subdirectory (such as \MEMOS, \LETTERS, \ARTICLES, and \BRIEFS) in which they store their various word processing data files. A RAM disk enables you to forgo that technique, which wastes disk space and inelegantly stores both application and data files in the same directory.

RAM disks also speed up the execution of applications that use "overlay files." To minimize the amount of RAM required, some applications load into RAM only the program code for their most frequently used features. This design technique is common among applications intended for microcomputers with 64K or less. When a lesser-used feature is needed, the application reads the appropriate code from an overlay file and writes that code into a small section of RAM reserved by the application for that purpose. The next time a lesser-used feature is called, its code is written to that same small section of RAM, overlaying the previous code. Because the overlay code must be read from a disk, features provided in this way are slower (and noisier) than features already in RAM.

Overcoming the deficiency of applications that do not recognize subdirectories and speeding up applications that use overlay files are the subject of the next item.

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Improving WordStar With a RAM Disk

Q. I get the feeling that most people who buy PCs eventually become hackers—or at least delve into the mysteries of programming and telecommunications. In my case, I have no such ambitions; I am a writer, and all I use with my XT is the ever-faithful word processor WordStar. *While the setup is quieter than a Selectric, I'm tired of listening to drive A: clank and rattle every time I need a* WordStar *function. Is there any way to minimize disk reads—and cut down on the racket?*

Alan Kenworthy
New York, New York

A. Using a RAM disk (see the previous item) on any PC will eliminate the noise that accompanies the reading of *WordStar*'s overlay files and speed up the process as well. Using a RAM disk will also enable you and other hard disk users of *WordStar* (which does not recognize subdirectory paths) to store your various data files in separate subdirectories, which will keep you better organized. For example, you could create a subdirectory for each new novel you begin. Each subdirectory could contain different files with the same name (such as CHAPT1, CHAPT2, CHAPT3, and so on). CHAPT1 of the subdirectory \BLUEMOON (\BLUEMOON\CHAPT1) will never be confused with CHAPT1 of the subdirectory \TALLTALE (\TALLTALE\CHAPT1).

First get a RAM disk utility (preferably one that allows you to specify the size of the RAM disk in 1K increments) and learn how to install it (directions accompany the RAM disk software). For *WordStar* version 3.3, the largest PC version, you need a 98K RAM drive to hold a file allocation table (which keeps track of which parts of the disk are and are not in use), a file directory (which stores the file's name and size, the date and time it was last saved, and other information), and the three *WordStar* files (WS.COM, WSMSGS.OVR, and WSOVLY1.OVR).

Next you must modify WS.COM, which currently looks for its overlay files on drive A:, to look for those files on the RAM drive. If you have *WordStar* version 3.3, you can use the WINSTALL program to make this change to a copy of the *WordStar* disk you now use. (Keep your current disk unchanged so that you will have a version of *WordStar* that will run on machines for which you cannot install a RAM drive, such as those with a small amount of installed memory.) At the DOS prompt type **WINSTALL** and press <Enter>. Answer the prompts until you reach the Installation menu, and then press **E** for the menu of *WordStar* features. Press **R** for the System Disk Drive option. Press **C** to change the current value of 1, which indicates drive A:. Enter the new value that corresponds to the drive letter you

want for the RAM drive. Answer the prompts as they appear and press **X** until you reach the Exit Options menu. Then press **A** to save the changes made during the WINSTALL session. You now have a copy of *WordStar* that will call its overlays from the RAM drive. (The copy cannot be used without the RAM drive.)

If you are using *WordStar* versions 3.2, 3.2M, 3.21, 3.24, or 3.24*, you can use DEBUG instead of WINSTALL. (If you have version 3.02, you can get a free update by taking your original *WordStar* disk to your dealer.) The patch to change the drive on which WS.COM will look for overlay files was incompletely printed in "WordStar Made to Order," (*PCW*, Vol. 1, No. 2) but was corrected in "WordStar Patches–P.S.," (*PCW*, Vol. 1, No. 3). The correct patch is reprinted in this column.

Copy DEBUG.COM from the DOS Supplemental Programs disk onto a copy of the *WordStar* disk you normally use. At the DOS prompt type **DEBUG WS.COM**. Then type **F 2DC L1** followed by a space and the numerical position in the alphabet of the RAM drive letter you want. For example, if the RAM drive is drive D:, type **4**. Then press <Enter>. Type **F 1E04 L2 90 90**, press <Enter> again, and

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type **E < Enter > Q < Enter >** . Readers without hard disks can skip the next paragraph.

Now that WS.COM has been patched (by WINSTALL or DEBUG), return to the DOS C> prompt and create a subdirectory for your *WordStar* program files. To do that, type **MD \WORDSTAR < Enter >** . Change the current directory to \WORDSTAR by typing **CD \WORDSTAR < Enter >** , and copy the patched version of WS.COM and the two overlay files to that directory:

```
COPY WS.COM C:
COPY WSMSGS.OVR C:
COPY WSOVLY1.OVR C:
```

Now modify the AUTOEXEC.BAT file. If your RAM drive software is a DOS program, put the appropriate command in the AUTOEXEC.BAT file. Put in the COPY commands that will copy the three *WordStar* files into the RAM drive (from the disk in drive A: if you don't have a hard disk or from the \WORDSTAR subdirectory if you do have a hard disk). Now *WordStar* can be called from the RAM drive, and when it calls its overlays, it will do so quietly and quickly.

For hard disk users, to facilitate using your RAM-based *WordStar* with your hard disk's subdirectories, add the path C:\BATCH to the current PATH command in the AUTOEXEC.BAT file. (If there is no PATH command in the AUTOEXEC.BAT file, insert the command **PATH C:\;C:\BATCH** into the file.) Return to the DOS C> prompt and create subdirectories for your batch files, letters, memos, and various novels:

```
MD \BATCH < Enter >
MD \LETTERS < Enter >
MD \MEMOS < Enter >
MD \BLUEMOON < Enter >
MD \TALLTALE < Enter >
```

Now change the current directory to \BATCH (type **CD \BATCH < Enter >**) and create the batch files that will quickly bring up *WordStar* with the appropriate subdirectory on drive C:. Assuming the hard disk is drive C: and the RAM drive is drive D:, type:

```
COPY CON: LETTER.BAT < Enter >
C: < Enter >
CD \LETTERS < Enter >
D:WS %1 < F6 > < Enter >
```

The next time you start up your PC, you can type **C:LETTER** *filename* **< Enter >** , and regardless of the current directory or the default drive, the PATH command will ensure that LETTER.BAT is found and executed. The batch file will make sure C: is the default drive and \LETTERS is the current directory and then call *WordStar* to edit *filename*. Create similar batch files to invoke *WordStar* for each of your subdirectories. The procedure is the same as that shown for LETTER.BAT except for the name you give the batch file (in the COPY command) and for the name of the desired subdirectory (\LETTERS in the CD command).

Swapping Serial Port Addresses

A couple of readers have informed me that swapping the serial port addresses in the ROM BIOS Data Area ("Swapping Ports With Assembly Language," *The Help Screen, PCW,* Vol. 2, No. 11) to switch COM1: and COM2: works only with those programs that use interrupt 14 hex to send data to a serial port. The technique does not work with programs that use interrupts B or C to output serial data. Such programs include most commercial software packages and BASIC as well. Because these programs have their own serial routines and set the vectors for interrupts B and C when they are loaded, it is not possible to swap those vectors before such programs have reset the interrupt vector values.

Do you have any questions concerning the IBM PC or compatibles? Send them to The Help Screen, PC World, *555 De Haro St., San Francisco, CA 94107, or electronically to CompuServe 74055,412 or The Source STE908.*

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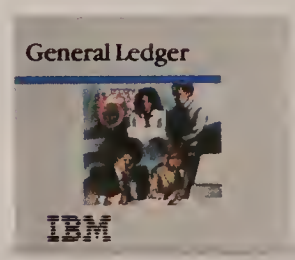

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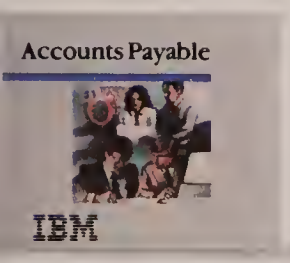

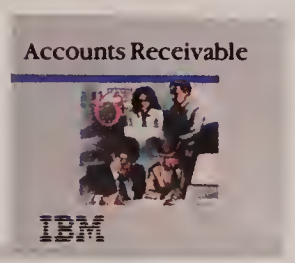

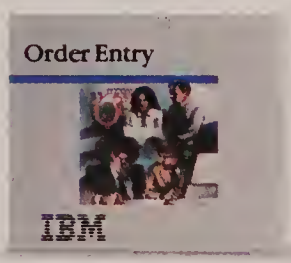

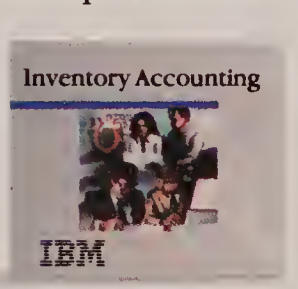

like the PC/XT. It lets you store them, permanently, inside your machine. Very handy. Here's another tip. IBM's new Personal Decision Series (for spreadsheets, writing, graphing, etc.) can take information directly from BMS. Very, very handy. And ask about IBM Extended Support, a way to get software updates and telephone assistance, direct from IBM.

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The Organization LAN

As companies find themselves contending with a multitude of PCs, choosing and setting up a local area network become imperative. PC World talked with David Ferris and Tim Sammons, two of the luminaries in local area networking, about the necessity of networking now and in the future.

Edited by Robert Luhn

A personal computer by definition is a standalone, personal device. Therein lies its attraction, for the user is in the driver's seat, processing and storing data at his or her whim. Of course, personal computers such as the PC are not exactly islands; floppy disks are easily shuttled among machines. But as an organization grows, so does its need to efficiently store, retrieve, update, and correlate the data it collects and uses. As time goes by, users are often compelled to move up to the XT, AT, or other hard disk systems, and eventually to share their data and storage with other computers in the office via a local area network, or LAN.

The concept of networking isn't new to most large corporations. For years mainframe terminals have brought a measure of computing power to big

"If a LAN vendor starts talking gobbledygook to you, stop the conversation and ask, What does it mean to my business?"–Tim Sammons of Sammons and Associates.

"Companies underestimate the amount of technical tickling a network needs– everything from putting in a network card to writing utility programs. These are not trivial endeavors."–David Ferris of Ferrin Corporation.

business desk tops. But the enthusiastic response to the PC and its peers has added a new wrinkle to the issue of corporate networking. Large corporations must not only link PCs together but must tie them into existing corporate computer resources. For the small to medium-size business with a gaggle of PCs, networking offers a way to wrest the greatest efficiency from the computers and peripherals on hand—and a means to keep up with larger and better-heeled competitors. Whatever the size of the business, the need for networking PCs is clear, even if issues surrounding the maturity of the technology and the marketplace are fuzzy.

Deciding which network to buy and when to buy it is no simple job. (For more information see "Six Leading LANs" and "Untangling Networks" in this issue.) The LAN marketplace today is not unlike the personal computing market of 1981. Confusion is the byword, and standards—de facto or otherwise—have yet to surface. People are once more waiting for IBM to drop the other shoe, this time on the head of telecommunications giant AT&T, Big Blue's likely competitor. The two behemoths are slowly circling one another, announcing new computers and networks, investing in high tech companies and, on occasion, buying these companies outright. Who will dominate in the LAN market remains to be seen: IBM has the reputation and marketing muscle; AT&T, the technological prowess and an unmatched installed network—the phone system.

And what of the small network vendor? Will existing network companies such as 3Com, Nestar, Corvus, and Novell be left out in the cold or crammed into specialized niches? Should the prospective network buyer take the plunge now or wait for the battle of the network acronyms?

In an attempt to shed some light on these and other questions, *PC World* Associate Editors Ken Greenberg and Robert Luhn talked with David Ferris and Tim Sammons, two nationally known experts on local area networks. David Ferris is CEO of the San Francisco-based Ferrin Corporation, a personal com-

puting services firm that specializes in product evaluation and planning, hardware and software installation, software development, training, and ongoing support. Past and present clients include such corporate titans as Bank of America, Del Monte, and American President Lines. Tim Sammons is director of Sammons and Associates, a Berkeley, California, computer consulting firm that was selected last year by the Democratic National Committee to coordinate the first computerized and networked political convention. Among the firm's Fortune 500 clients are Chevron and Bank of America. The following is an edited version of the conversation that took place.

PCW: It seems that no one is rushing to embrace LANs—even the superior LANs. Why hasn't the LAN market taken off?

Sammons: Users aren't gullible; they know what they need. They've had a hard time matching that with what the computer industry provides, because the industry hasn't been listening very well.

Ferris: It's easy to forget that it takes a long time for people in the marketplace to learn about a new technology. I'm confused as well. IBM's involved with Sytek [developer of the company's broadband LAN], yet owns Rolm, a PBX developer. PBXs are an attractive alternative to networking that make terrific sense. A PBX can send data down a telephone line very, very quickly. The phone system is a magnificent network and it's already in place.

PCW: Which gives AT&T a substantial headstart over IBM.

Ferris: Absolutely. Many of our clients who've made major commitments to IBM mainframes and microcomputers have also made major commitments to AT&T PBXs.

PCW: How long will it be before AT&T has the marketing savvy it supposedly lacks to compete effectively with IBM?

Sammons: I don't think AT&T lacks much. It just hasn't been in the public eye the way IBM has. IBM has always been able to manage the media. When you think of IBM you think of computers. When you think of AT&T you think of phones, of a utility. So it's mostly a matter of perception.

PCW: Then it's not simplistic to see a confrontation brewing between these two giants? Will a standard emerge when the dust settles?

Sammons: There's going to be a serious tussle between IBM and AT&T. For a long time IBM said, "Don't worry about us. The phone company is the phone company and we're the computer company; you buy your data from us and your voice from them." But with the breakup, AT&T is a direct competitor. And right now, AT&T has the lead in fiber optics and laser technology—the places that really count.

Ferris: I think it will be very interesting. LANs are realistic and will have their chunk of the market; PBXs are going to have theirs as well. There are going to be shakeouts, with two or three companies dominating each area. The big boys—IBM and AT&T—will survive, as will some of the current vendors such as Sytek, Ungermann-Bass, and 3Com. And I think it's reasonable to expect Rolm and Microsoft to become major players. Large corporations won't be able to choose one technology over the other for the next three or four years, though I think many companies will go the PBX route. IBM's dealings with Rolm are certainly significant in that area. Some companies may end up doing quite a bit of networking using a mainframe as a central node.

PCW: If LANs are realistic, what's holding the market back—a lack of system and application software?

Ferris: As a matter of fact, I don't think so, although [that lack] is a limiting factor. Software is a sine qua non if LANs are to make any significant penetration in the market. It's imperative that software vendors tailor their software for networks; that *1-2-3* works on LANs; that data base software offers some level of backup, recovery, and file and record locking; and that data integrity in a shared environment is assured.

What's been done by most software vendors so far is pretty halfhearted. We were disappointed with the multiuser version of *dBASE II*, but it's good that someone is taking some first steps. And let's face it: software companies have finite resources. They've got to put their energy into areas where they're going to see cash. If IBM does even a halfway-competent job with their network, it's going to attract developers.

It takes ten years for a new technology to become common in the marketplace. It's taking longer for users to learn that they need to hook their computers together—and longer still for that need to be filled.

Sammons: The big problem is that IBM and AT&T just aren't in the market yet. I don't think they're going to sit back on their haunches; they're going to enter the marketplace. But IBM is like the Republican party. It waits until the issues are well resolved and then jumps into the middle and moves everything to the conservative edge.

'IBM is like the Republican party. It waits until the issues are well resolved and then jumps into the middle and moves everything to the conservative edge.'

PCW: What about current offerings from both AT&T and IBM? How does the Sytek LAN compare to AT&T's 3B2 network?

Sammons: They don't really compare at all. The Sytek network is pretty stripped down, which is why IBM liked it. It's technologically sound, it can carry videotex with no real problems, and it can probably network computers from 20 different manufacturers. It certainly meshes well with the economies of mass production. The 3B2 network is fast and well designed, but most people don't need it—and they wouldn't want to pay for it.

PCW: Can you expect much from 8088-based networks?

Ferris: Undoubtedly, yes. But we must also agree that there are severe limitations. The PC's 8088 [microprocessor] isn't really capable of some important functions, namely the sort of concurrent operation a good multitasking system can offer. A PC can run one task in the background, typically the printer. But the PC is definitely enough for an attractive level of networking.

PCW: By attractive you mean . . .

Ferris: Data sharing, primarily. It's nice to share printers conveniently, too, but you can't justify the cost of a LAN on that basis alone. People really need a network to share data. Let's say that a company has developed an order entry or order tracking system in *dBASE II*. They've got one person entering and changing the orders. The business grows, the system is used by more and more people. Disks are all over the place. People have different and out-of-date copies of the data base. In some businesses, this is acceptable.

But if that order entry system is your lifeblood, the key to effective customer service or to your receivables—to the money in your pocket—then it's time to bite the bullet and get into LANs. It's worth the $2000 or $10,000 investment.

Sammons: Networking is much more attractive when you consider using non-8088 machines. Consider the possibilities of an intelligent, interactive data base management program that allows you to window mainframe data and simultaneously update multiple locations in a file. Those features exist in data base management programs; unfortunately, they run on IBM mainframes, not on 8088-based micros. That will change with the [Motorola] 68020 [microprocessor]; it has the power to support concurrency, record locking, and even field locking.

PCW: Where does the PC AT fit into the LAN scheme?

Sammons: If nothing else, it's going to replace the PC as a network's work station. The AT costs about $5000 now. It'll start with the department manager having an AT; that will be the department's focus of information flow. Others who have PCs will be networked to the AT. Once all the PCs have been depreciated and written off three years later, companies will then go out and pay the money—$5000, or maybe only $2000 to $3000 by then—to get AT performance for everyone.

PCW: What about LAN alternatives, such as multiuser systems from North Star and TeleVideo?

Sammons: North Star has a good technical concept, but I've never been impressed by its R & D department's responsiveness to marketing pressures. If North Star ever wakes up and understands what users really need, it could do very well.

Ferris: Multiuser systems make sense in some situations, but they have nothing to do with personal computing. In that regard, they're really a waste of time. It's silly to have any number of users sharing a $100 microprocessor and at the same time working with an incredibly complex operating system with all its attendant bugs. I can see sharing a $50,000 processor, but then we're not talking about microcomputers anymore.

'Administrative duties never go away with a network. Planning is essential; you have to think through the problems of computer systems administration; if you don't, you'll pay a penalty before very long.'

PCW: But what's the real difference between an 80286-based multiuser machine serving ten users and a typical LAN with ten work stations?

Ferris: Up to a point it might not make a bit of difference to the user. But as you add users, there are certain advantages to a LAN. You get better response time and there's less chance of a central processor crashing. On the minus side, a LAN is susceptible to a hard disk server crashing—and to the whims of software vendors.

Sammons: Multiuser systems—shared logic systems—are generally easier to set up and they have more powerful processors. Multiuser systems got a bad name because companies claimed their systems would support 12 users when 2 users was probably more realistic. But I think the kind of processing power offered by the 68010 and 68020 can make these systems work.

PCW: What do companies usually overlook when they decide to network?

Ferris: They underestimate the amount of technical tickling a network needs—everything from putting in a network card to organizing all the files on the server and writing utility programs. These are not trivial endeavors. Companies also don't realize that they will need someone in-house who knows how to administer files, do backup and recovery, add new users, change user passwords, and so on. Administrative duties never go away with a network. Planning is essential; you have to think through the problems of computer systems administration; if you don't, you'll pay a penalty before very long.

PCW: Is it crucial for a business to have a working knowledge of such things as data transfer rates, topologies, protocols, cabling, and so on?

Sammons: You have to translate those technical terms into functional business activity. If a LAN vendor starts talking gobbledygook to you, stop the conversation and ask, What does it mean to my business? Either you take the time to learn those things or you hire a consultant. If I wanted to buy a high-performance race car, I wouldn't pick one because it looked nice; nor would I test drive it, because I'm not a race car driver.

If your company has only one operating division or 50 employees, I wouldn't spend a whole lot of time worrying about the LAN's spec sheet. I'd try to get the best possible deal—and a written guarantee that the LAN would do what I wanted it to do. As long as you keep in mind the basic functionality you want, you can't go seriously wrong; most LANs will more or less do the job.

PCW: Is a consultant with systems experience vital to anyone installing and using a relatively large network?

Ferris: Well, this is a little bit of a sales plug, but they probably will need someone like us. A small business won't like the fact that we're going to charge them around $100 an hour, but sooner or later they discover a qualified consultant's expertise pays off.

PCW: An industry rule of thumb says that most companies are unwilling to pay more than 15 percent of a system's price to link it to a LAN. Is that a reasonable figure?

Ferris: It's grotesquely absurd, because the real costs are much higher. This market is still fairly immature, and common sense hasn't emerged yet. Everyone is confused right now, and as a result you see companies rushing into networking without considering the real costs. They don't consider how long it will take their people to learn to use the system, much less maintain it. They'll need a consultant, at the going rate of $60 to $120 an hour, to implement the LAN. A job like that typically costs our clients $15,000, and we're pretty technically adept. Installation may involve adding menus to the network, converting programs, and handling all the minutiae I mentioned earlier.

When it comes to in-house expense, remember that employees will have to spend time learning to use the system. The salary cost, with overhead, can be as much as $250 a day per person. At the very least, you have to hire a half-time system administrator. More likely you'll reassign someone to the job and fill the vacant position. That's another cost that's commonly forgotten.

PCW: Are DP [data processing] departments in large corporations hostile to the concept of personal computers and LANs?

Ferris: That might have been the case three years ago, but we don't see that today. An MIS [management information system] director or a DP manager can't afford to say micros are no good, because his or her credibility would be shot. In fact, half our clients are DP departments that need to supply services to users in the company. The practical problem is getting a budget commitment from top management—they don't really see personal computers as part of their overall computing resources.

PCW: Of course, one of the original arguments made for the personal computer was that it freed the user from the stultifying control of centralized processing. Won't networking PCs bring that back?

Sammons: Oh, sure. Control and centralization of information processing are compelling reasons to get a LAN. I think we'll see some companies go back to a centralized operational structure. Others will centralize locally so a given manager will be able to review the work done by his or her staff. But the key for large companies is not so much networking micros as networking micros to mainframes.

PCW: Given all the caveats, why should anyone invest in a network today?

Ferris: Because the needs—for data sharing, for efficiency—are compelling. We do warn clients that network technology is emerging and to expect to write off the hardware and software they invest in over a two-year period—and start afresh with new LANs after two years.

As with personal computers, there's a point when the benefits outweigh the costs. We've all discovered that computers have an insidious way of becoming the crux of a business. They're initially bought on the isn't-that-a-lovely-spreadsheet impulse. Then the company discovers one data base application and then another and pretty soon finds itself depending on the computer. I think the same progression is going on with networks, though it's occurring much more slowly than we expected.

'As long as you keep in mind the basic functionality you want, you can't go seriously wrong; most LANs will more or less do the job.'

Sammons: There is no answer for all seasons or all companies. There are some good solutions coming out now, but nothing compares to what we'll see in two years. The point is, how much money will a LAN save you in operating costs over the next two or three years? That LAN may not be the end-all, but it might significantly improve your company's performance. The need varies. In some companies, profit

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margins are so tight and efficiency so high that LANs don't make a whole lot of sense; in others they're absolutely essential. If you've got 5000 people in an organization who have to be able to communicate in small groups, who need to share files and to window data from a mainframe, who need data quickly, it makes sense—particularly if your competitors are lowering the cost of their services with LANs.

Now if I were a CEO or a corporate DP manager wanting a fully capable voice-and-data network, then I'd wait. IBM isn't going to have such a product for at least another year.

PCW: What does the near future hold for networks and personal computers?

Sammons: I think the personal, stand-alone computer has about four or five years left. And by the time local area networks as we know them come of age, they'll be obsolete as well. The future lies in very-high-speed networks that integrate voice and data and blur the distinctions between the telephone and the computer. Then the whole notion of stand-alone vanishes. That's why I think broadband, fiber-optic-based networks are the future. You'll have a machine that "delivers" your morning paper, the Sears catalog, shopping services, and more. That's not stand-alone, but you will always be able to disconnect and go play on your own computer.

PCW: In the meantime, how do users assess their networking needs?

Ferris: It's a brutal learning curve, and most users don't understand that. Networks are hard to choose, buy, and install, and a lot of people are going to be disillusioned by the process. Certain technological developments will make LANs easier to install and use. But businesses that network their PCs are going to find that they need higher and higher levels of computer expertise, which translates into an initial period of disillusionment and discomfort. But at the end of that time, I think people will find that biting the bullet was worth it.

Robert Luhn is an Associate Editor for PC World.

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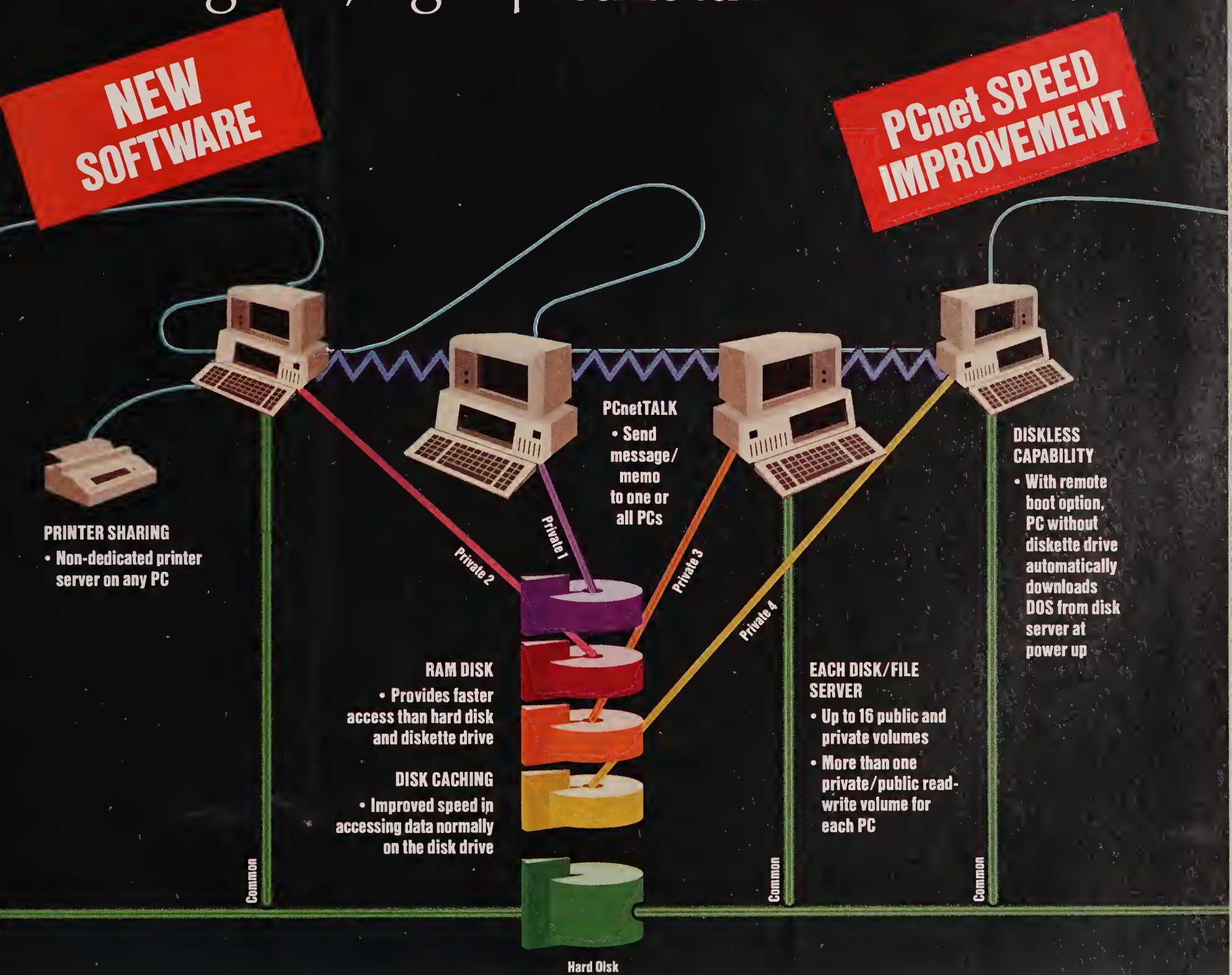

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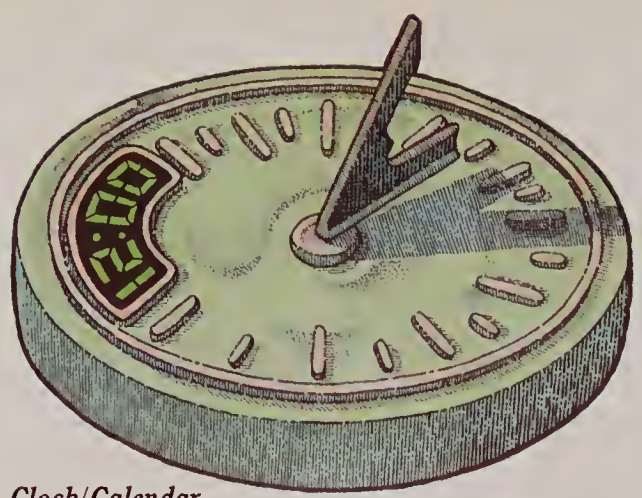

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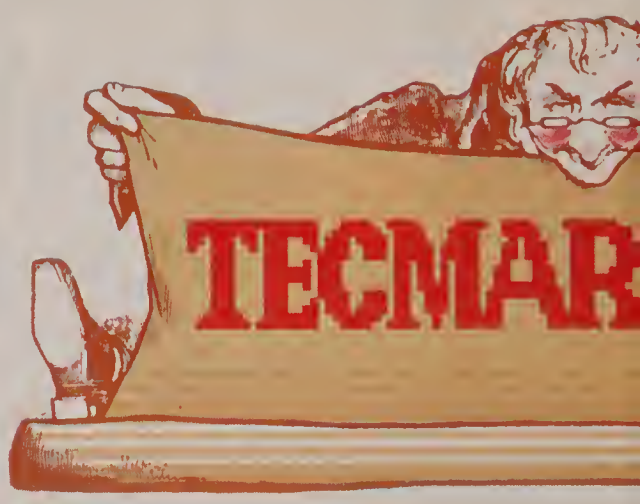

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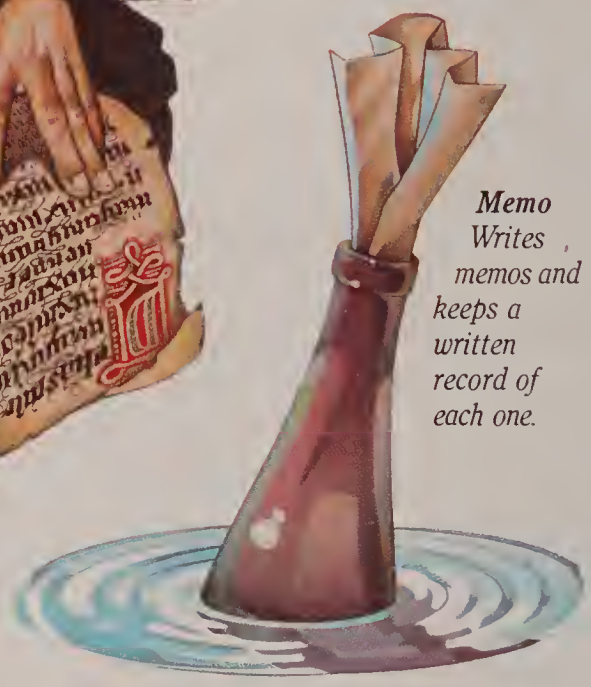

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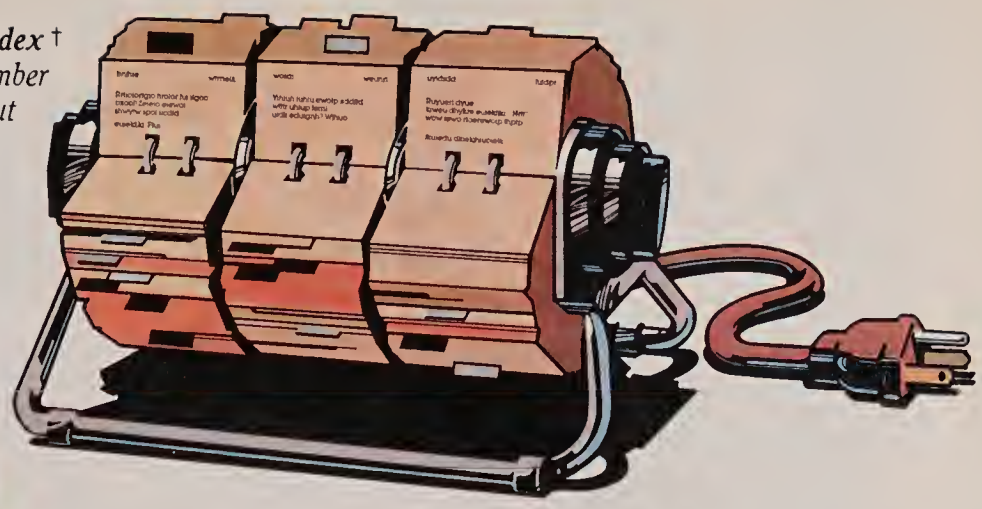

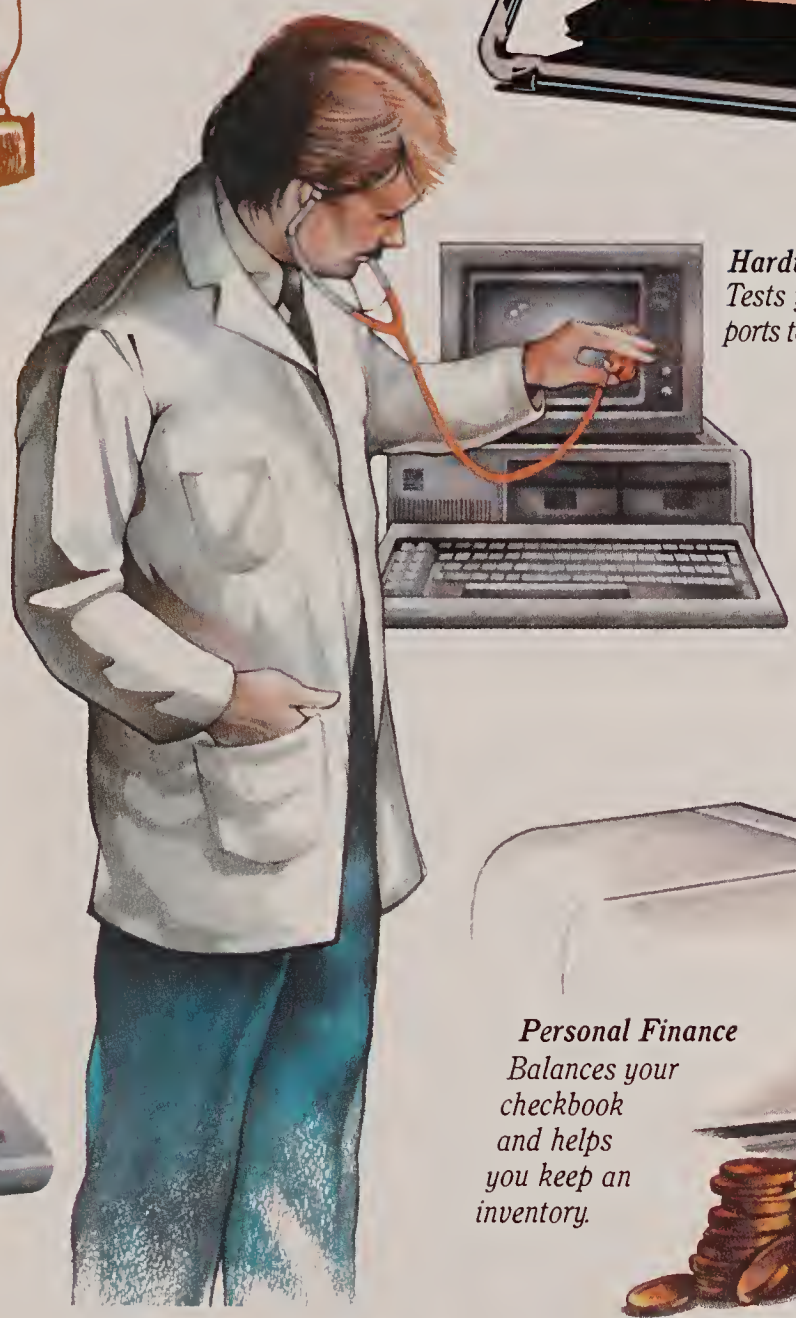

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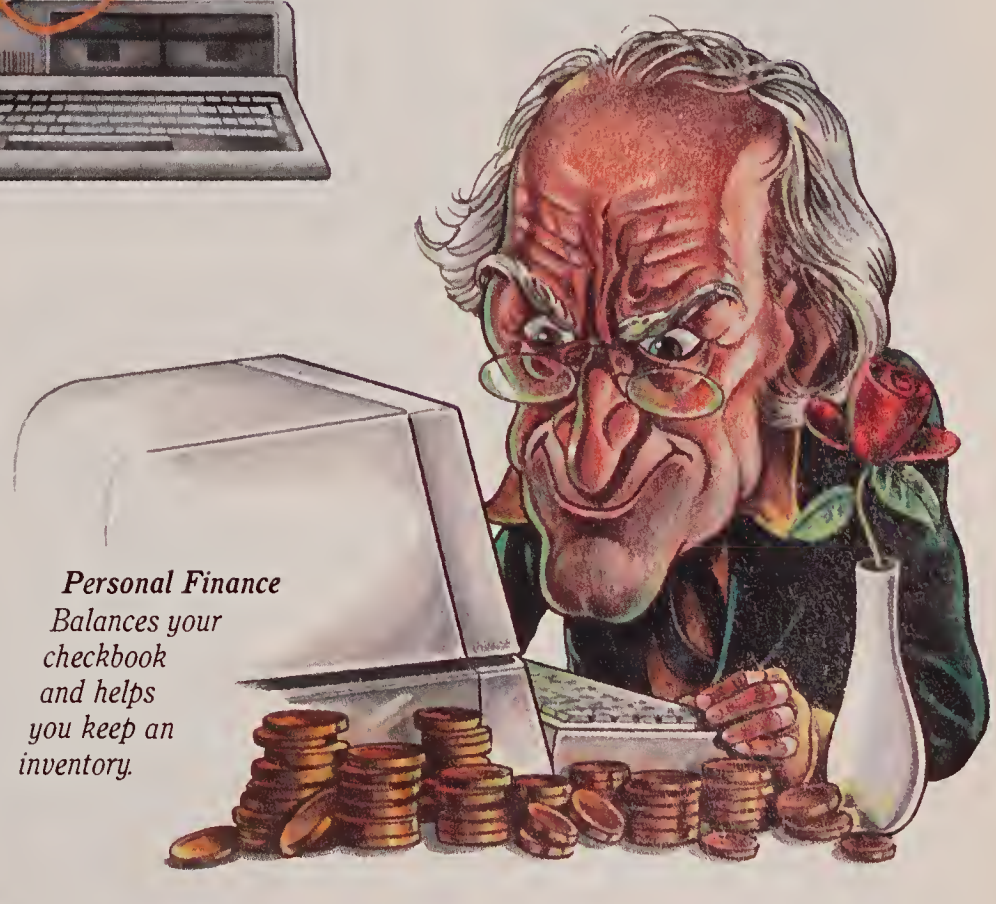

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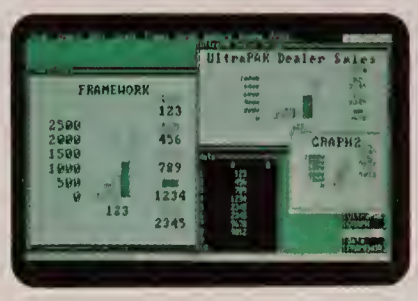

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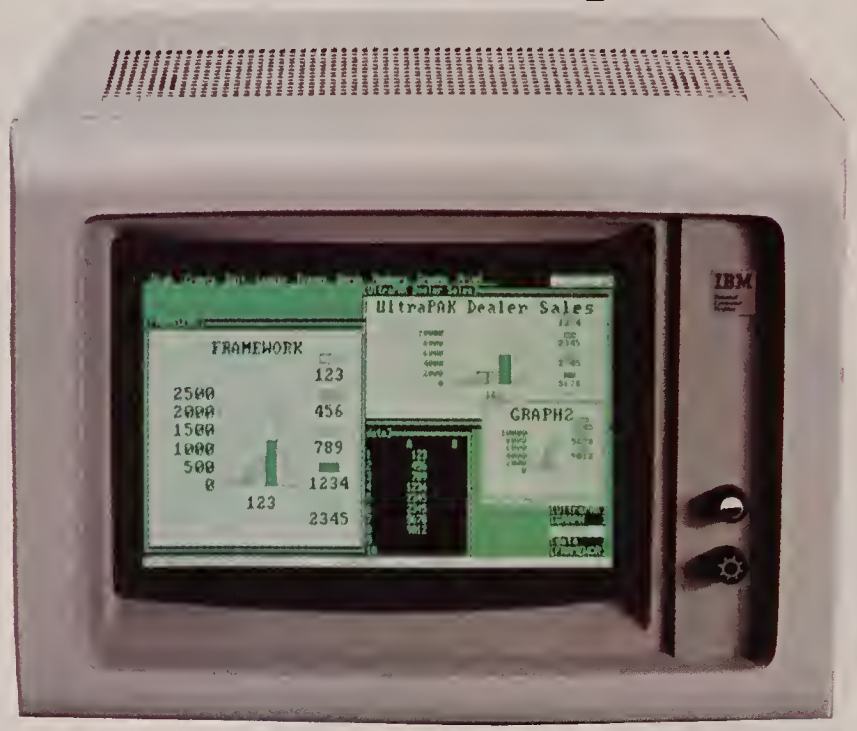

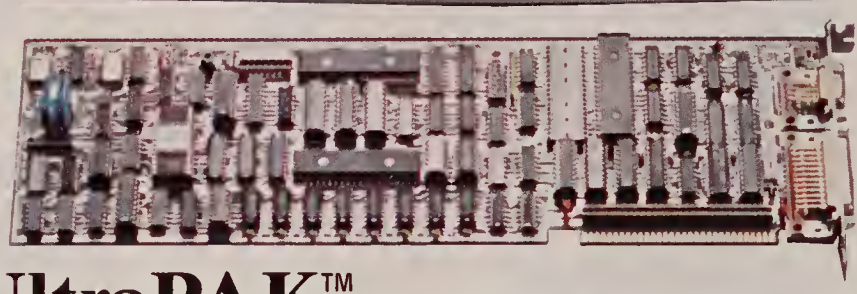

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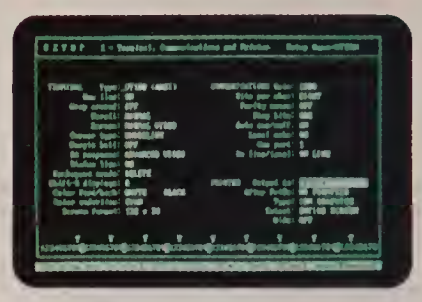

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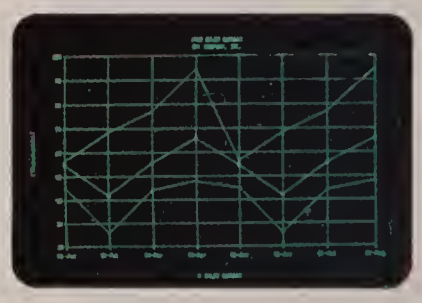

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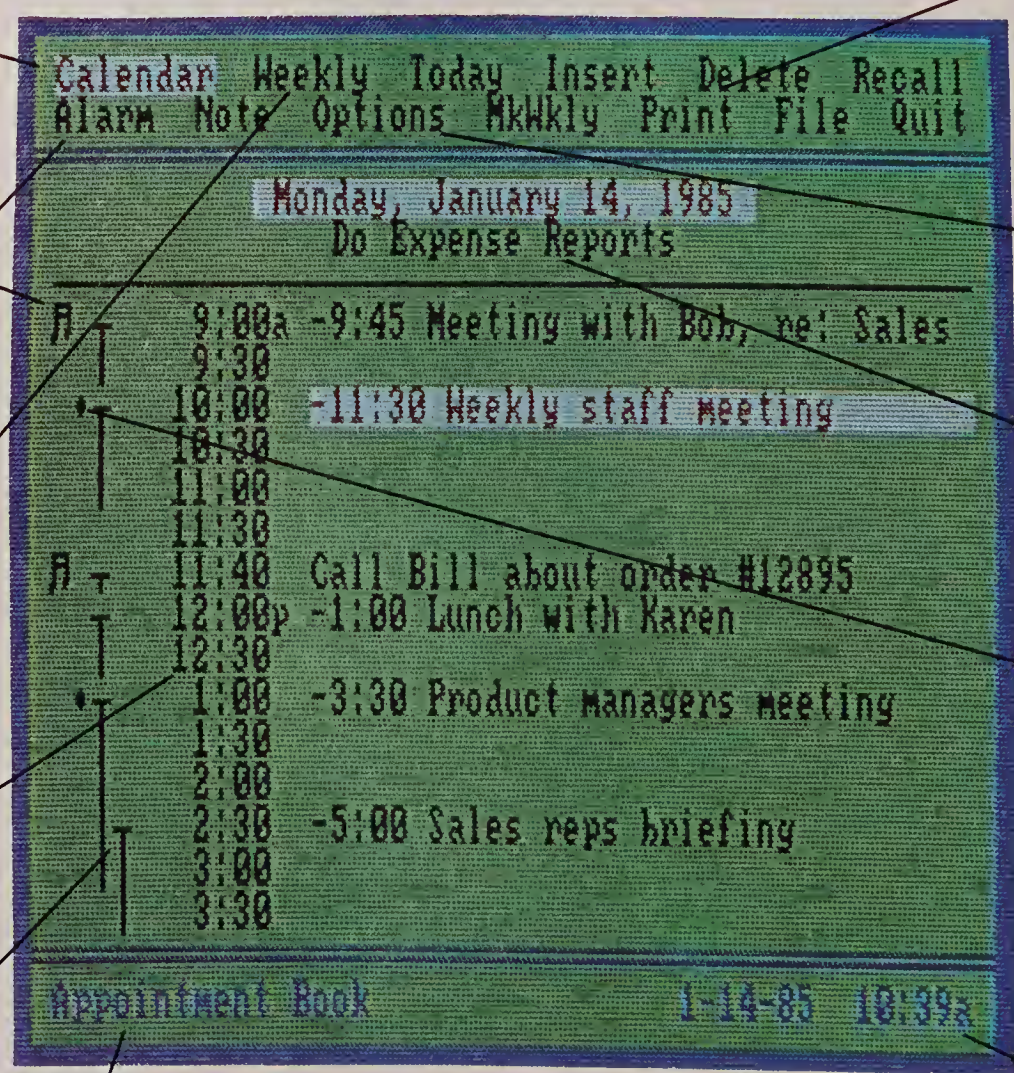

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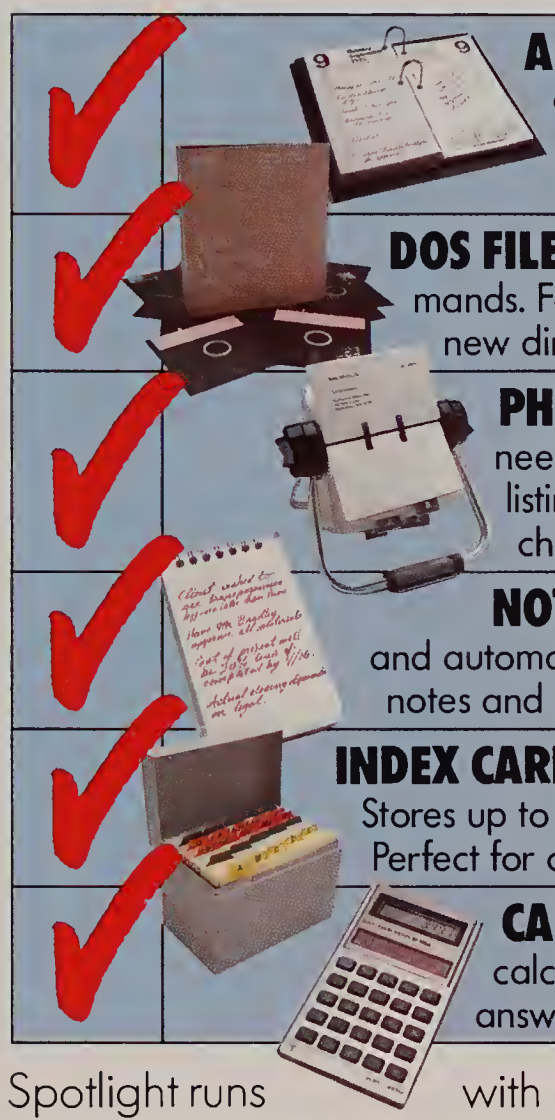

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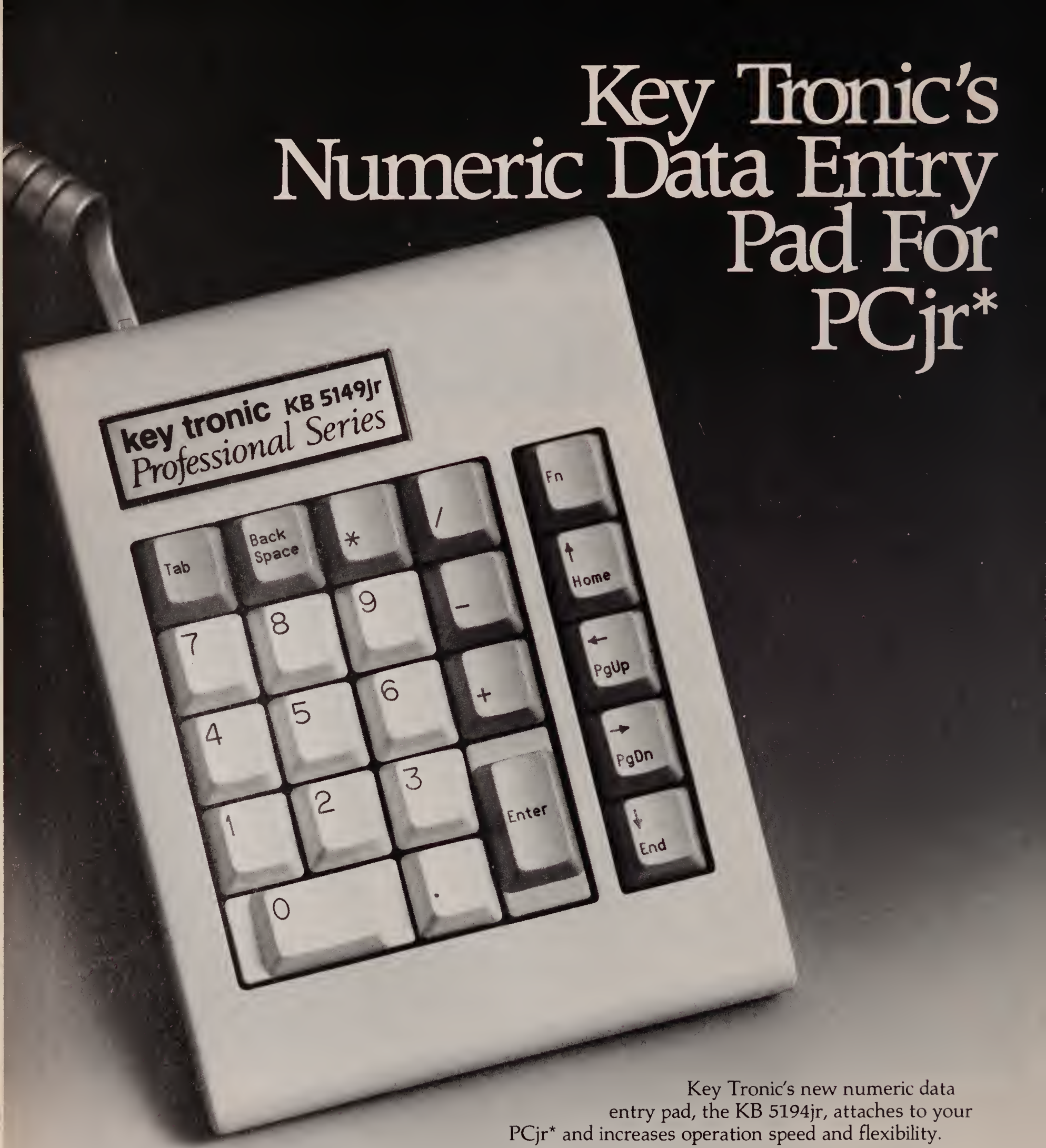

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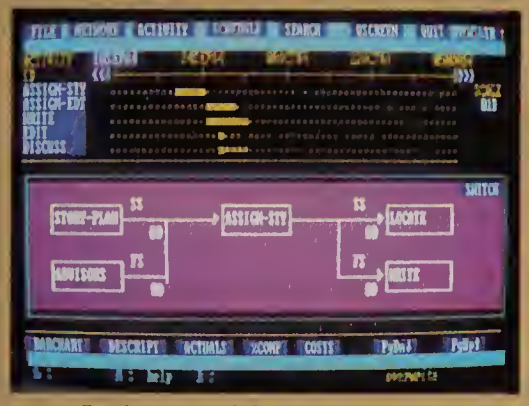

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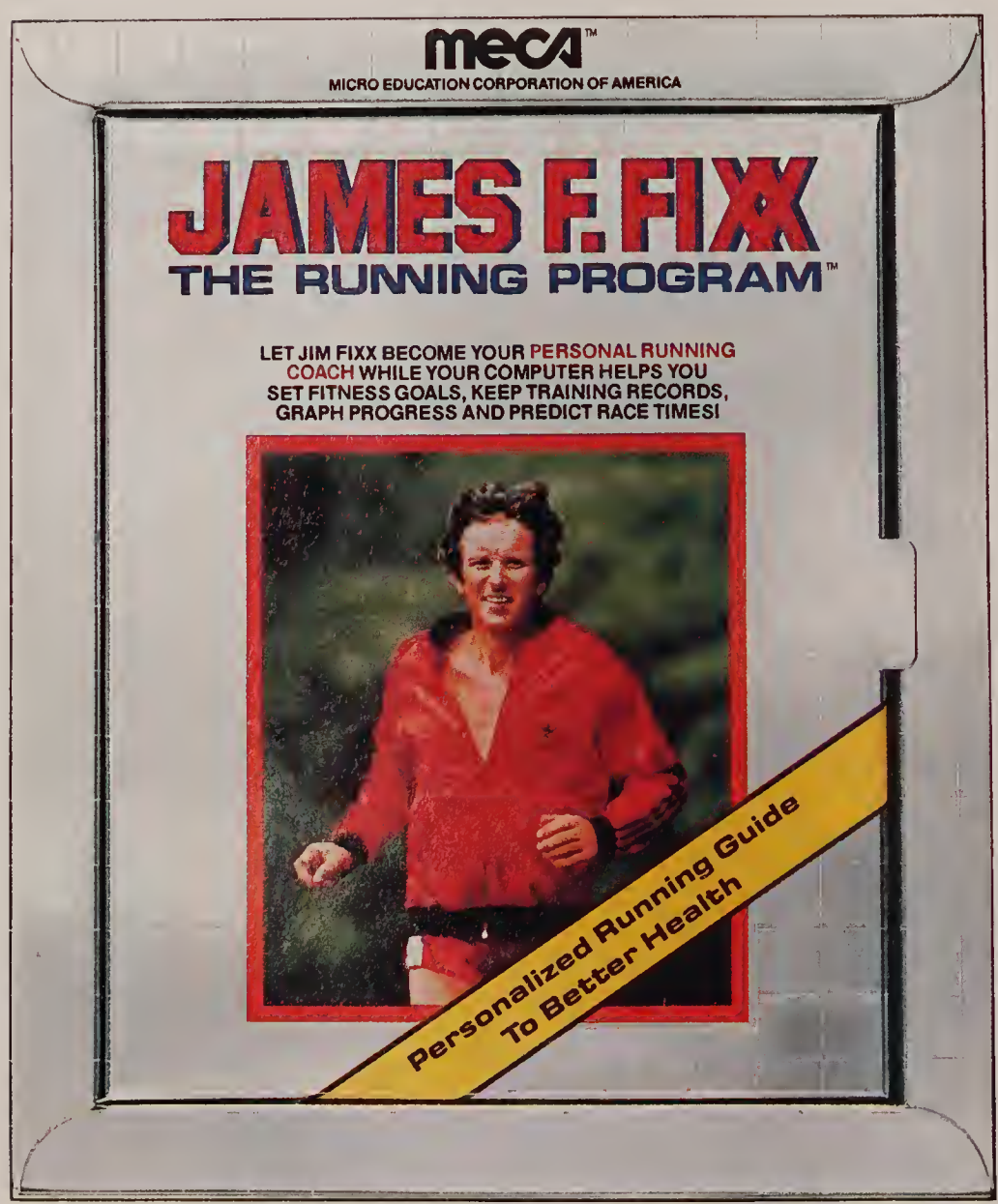

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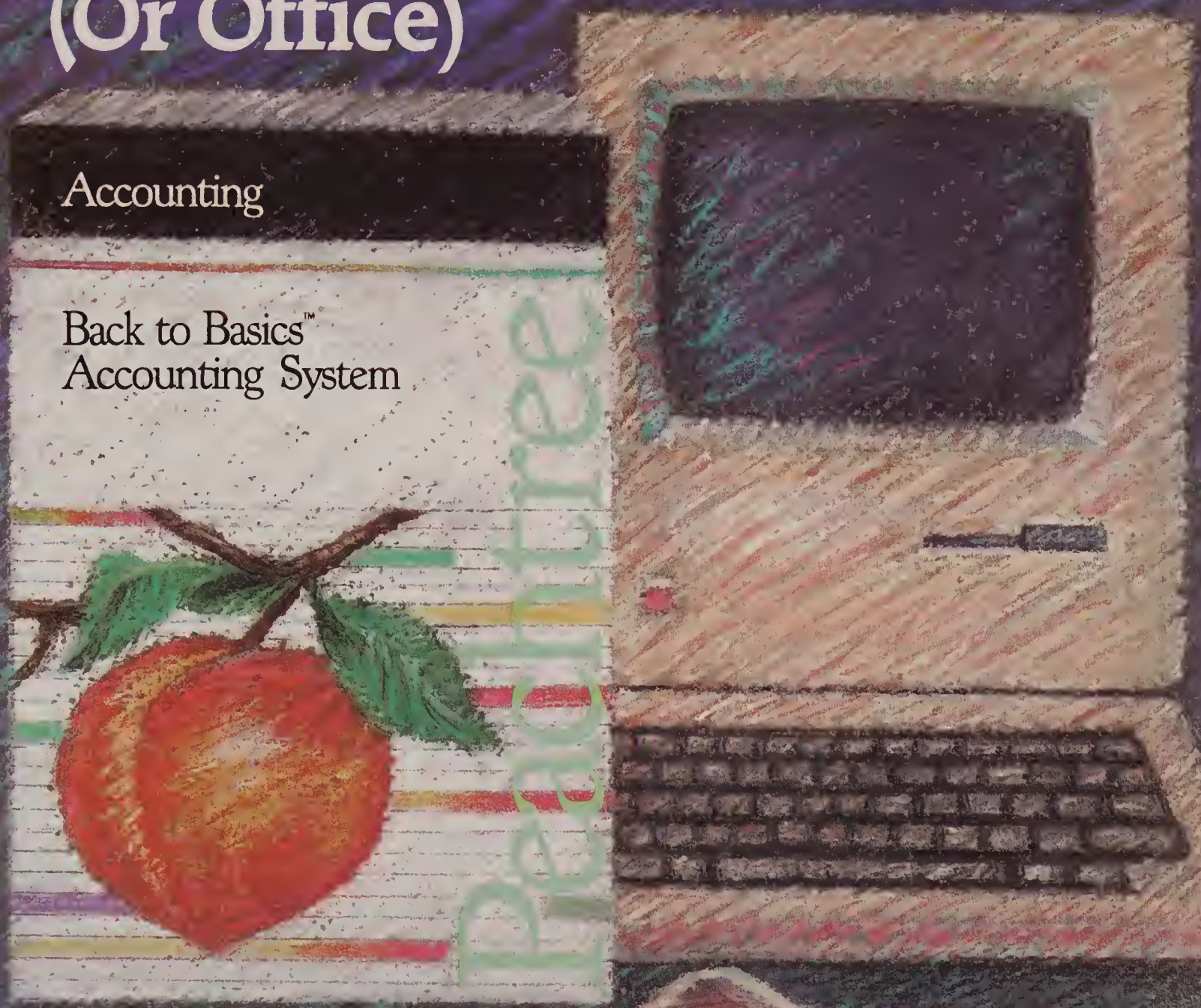

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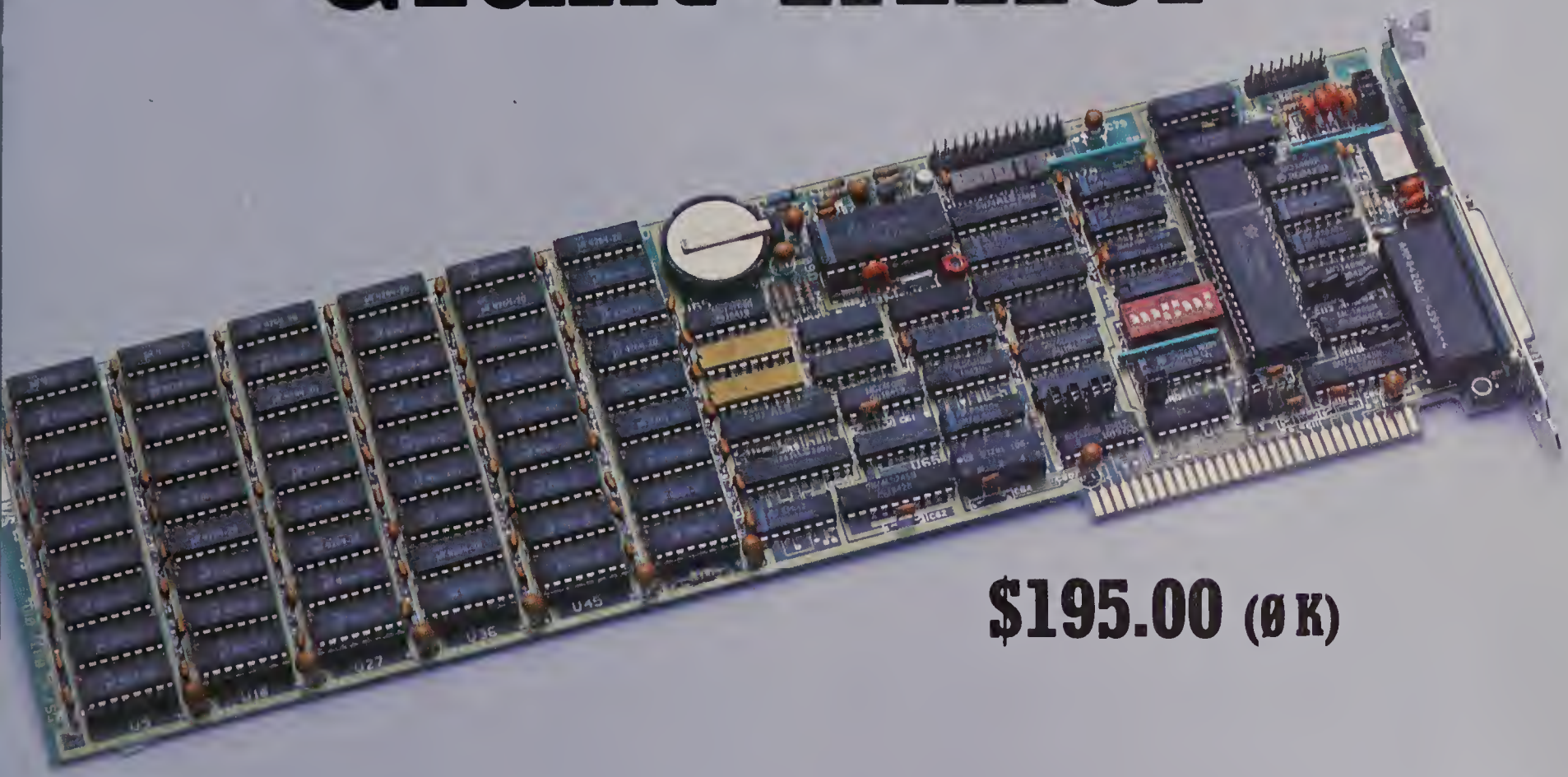
Giant Killer



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Compatibles Update

The latest developments in the PC-compatibles marketplace

AT&T gives PC clones something to glow about with a trio of graphics devices. This month's column also keeps score on who's winning and who's hanging on in the compatibles arena and assesses the TeleVideo TPC-II.

Ken Greenberg

Trends

"AT&T Compatible?"

While computer industry analysts jabber about whether the PC 6300–AT&T Information Systems' entry into the MS-DOS fray–is in demand, in ready supply, or even available, another AT&T unit is churning out products for PC 6300 clones.

AT&T's Consumer Products Division has unveiled a trio of graphics enhancements sculpted for, in the company's words, "AT&T and compatible personal computers." The offerings include a video display adapter, an image capture board, and a NAPLPS (North American Presentation Level Protocol Syntax) decoder. All three are aimed at the OEM (original equipment manufacturer) market and are expected to be available commercially this spring.

The video display adapter is a high-color resolution graphics board that enables personal computers to display continuous-tone, TV-quality images on color televisions, composite color monitors, and analog RGB monitors. AT&T is touting the board's ability to provide reliable, high-speed graphics display and manipulation. In high-color resolution mode, the board displays 256 by 256 pixels and a maximum of 256 colors (from a palette of 32,000 hues). A high-spatial resolution mode permits display of 80 columns of text on an RGB monitor.

The image-capture board enables personal computers to capture, digitize, and display continuous-tone, TV-like images, including graphics from a video source (such as a video camera). Like the video display adapter, the board is bundled with a host of software tools and image libraries. Both products achieve continuous tones by abundant color gradations rather than by great numbers of pixels.

The NAPLPS decoder enables computers equipped with an AT&T video display adapter to receive and display frames encoded in the NAPLPS standard for videotex (see "Toward a Graphics Standard," *PCW*, Vol. 2, No. 12). The package includes hardware and software that emulate the AT&T Sceptre videotex terminal.

For more information, contact AT&T Consumer Products, 5 Wood Hollow Rd., Parsippany, NJ 07054, 201/581-3000.

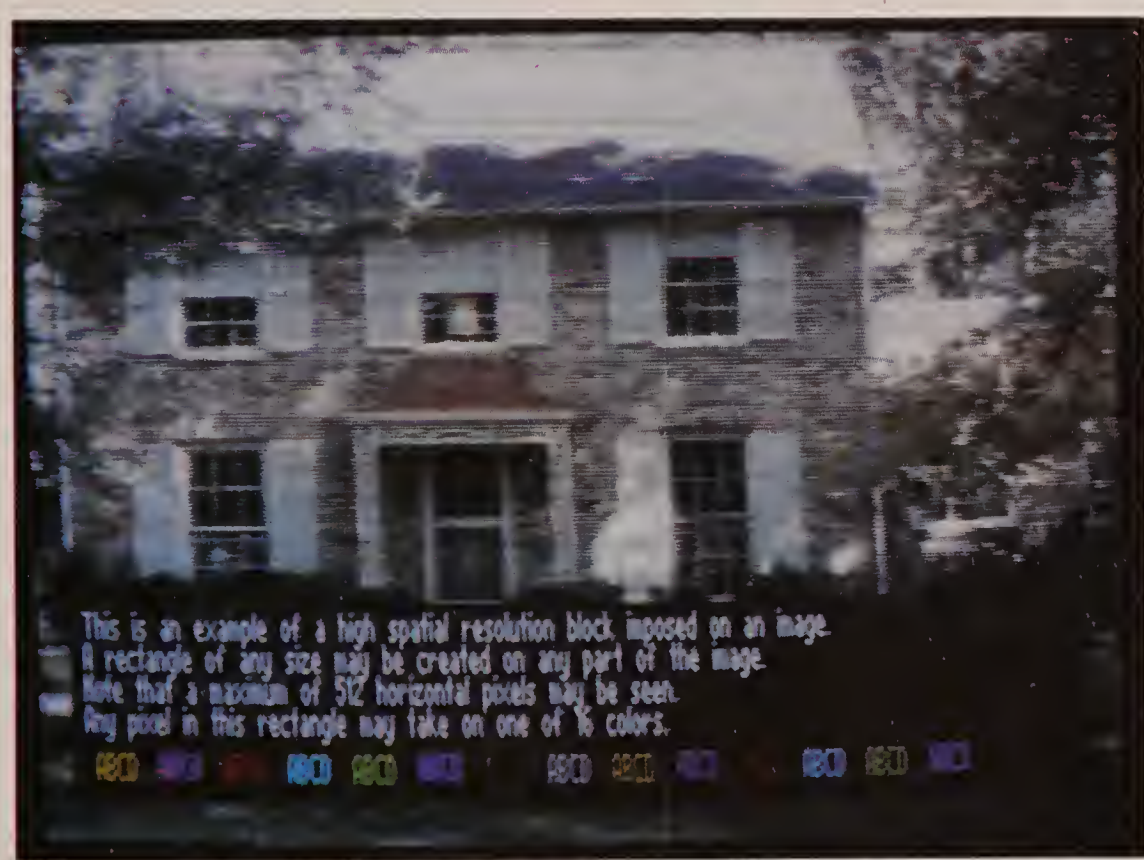
The People's Choice

IBM has not completely vanquished the compatibles market. Although the torrent of new clones has slowed to a drizzle, some stalwart manufacturers are selling their products in impressive numbers.

Zenith Data Systems, long a favorite of the Defense Department and the General Services Administration, continues to have Uncle Sam's number. The company has been awarded a $300 million contract to supply the air force and the navy with an estimated 30,000 Tempest-certified Z-150 PC compatibles. The pact is believed to be the largest ever for Zenith Data.

Tempest certification signifies that electromagnetic emissions from the machines are low enough to prohibit interception. Zenith

AT&T's PC 6300 equipped with the video display adapter exhibits a sharp, three-dimensional image on an analog RGB monitor.



The adapter enables you to superimpose text on a graphics image. It also permits you to create and move a rectangular block of any size anywhere on the screen.

will be shipping a dual floppy disk drive version and a hard disk version of the 8088-based Z-150 series.

Seequa Computer is also cashing in on the government's decision not to buy from IBM. Seequa recently struck a deal with Ford Aerospace for $1.5 million worth of Seequa PC and XT desktop computers, which will be distributed to NASA engineers in Houston. The Seequa line of PC work-alikes is based on an 8088/Z80 dual-processor architecture.

The Internal Revenue Service, meanwhile, is field-testing the GRiD Compass computer. The IRS has equipped a squad of tax collectors in western Massachusetts with GRiD portables. The revenuers want to determine whether briefcase computers bolster the speed and quality of field audits. (No word yet from local scofflaws.)

Survivors Box Score

When last we checked, a number of prominent PC-compatible start-ups were limping through the remainder of 1984—anything but a banner year for the clone-minded.

Eagle Computer and Columbia Data Products, perhaps the most visible among the hobbled, tinkered with strategies to restructure debt and avoid the fate that befell Gavilan Computer late last summer.

Gavilan, whose portable didn't quite make it into mass production despite the raves that accompanied the computer's introduction in 1983, filed for bankruptcy under Chapter 11 and then closed up shop. The firm departed the scene with $10 million in debts and reportedly fewer than 2000 machines in the "sold" column. The bankruptcy petition ended an executive shake-up and several rounds of layoffs.

In Garden Grove, California, Eagle Computer ended its fiscal year with a net loss of $24.7 million on sales of $48 million. Eagle experienced a particularly grim fourth quarter as the firm posted a $15.4 million loss on sales of $4.5 million. That compares with $11.6 million in sales for the final quarter of 1983.

The Chapter 11 wolf may be at the door, but Eagle has resolutely refused to let the critter in. The company made an initial $300,000 payment to some 170 unsecured creditors, reduced its roster of distributors from 30 to 8, and began to withdraw from retail channels in favor of the OEM market. But the company missed a second payment to creditors, renegotiated its voluntary debt repayment schedule, and lost Sam Goodman, its fiscal Mr. Fixit (see *Compatibles Update, PCW,* Vol. 2, No. 13).

Eagle followed its earnings report with yet another managerial switch. Cofounder Gary Kappenman returned as Eagle's president and CEO, bumping former chief Ronald Mickwee into the company's chairmanship. The re-

aligned firm then closed its Los Gatos, California, headquarters, consolidated its executive and manufacturing operations in Garden Grove, and reduced its staff by an estimated 50 percent.

In Maryland, Columbia Data Products is traversing similar territory in order to stay solvent. Amid losses, layoffs, and a $23 million debt, Columbia formed an advisory committee to devise marketing and internal operations strategies. The panel includes Samuel Irwin, chairman of Irwin Magnetics. Irwin's firm supplies streaming tape drives for the Columbia Professional and Compaq Deskpro. Upstairs, Robert Cross joined the company as CEO.

Other compatibles manufacturers aren't faring much better. Visual Technology endured a poor third quarter, largely due to an inability to gain retail shelf space for the Commuter, its PC-compatible portable. Visual trimmed prices on the Commuter last summer, further cutting into profit margins.

To spur sales of its Mitsubishi-made PC compatible, Leading Edge Products has begun offering an unbundled version of the machine for $1995. The company also reduced list prices on its 128K base system by $200 (to $2295) and its 256K system by $400 (to $2495). To energize dealers, Leading Edge launched a dealer incentive program; sell enough computers and Leading Edge will part with the keys to a Mercedes SL.

North Star Computers, which makes the PC-compatible multiuser Dimension (see "The Multiuser Dimension" in this issue), has cut its work force by 30 percent and reshuffled a few front-office assignments. The company, based in San Leandro, California, acknowledged that Dimension sales haven't met expectations.

Shortly after IBM released the multiuser PC AT, North Star began talking merger with Fortune Systems, another multiuser manufacturer wary of battling IBM alone. Although the two chose not to join forces, both say that joint projects are in the works.

Sheer size doesn't ensure against injury in the PC-clone wars. ITT's Xtra is taking a few hits in the market, and those knocks are reverberating throughout the ITT Information Systems Division executive suite. Division head Thomas Payne has been replaced by an ITT corporate vice president who immediately moved to reorganize the division.

ITT also refocused its Xtra promotional efforts, added a dealer incentive plan (Chevrolets, not Mercedeses), and offered buyers immediate $700 rebates on Xtra purchases. The company's three-month exclusive with ComputerLand expired last summer, but independent dealers reportedly aren't much interested in picking up the Xtra. ITT has vowed to supplement the product with new offerings in the telecommunications field.

In Review

Look Ma, No Fan

Within the past year the market has exploded with transportable personal computers vying to repeat Compaq Computer's success. TeleVideo Systems–known for its terminals, monitors, and 8-bit computers–has joined the PC-compatibles bandwagon. The company's line includes a desktop (the TS 1605), a hard disk desktop (the TS 1605H), and a transportable (the TPC-II). If the trend toward portability continues, the TPC-II may have a good chance to make its mark in the crowded compatibles field.

In both price and features, the TPC-II competes directly with the Compaq portable and IBM's Portable Personal Computer. The TPC-II weighs 30 pounds, stands 7.9 inches tall, and measures 18 inches wide by 15 inches deep. Based on the Intel 8088 CPU, the TPC-II comes with 256K RAM installed on the motherboard. RAM can be expanded to 640K by inserting a memory board into the one free expansion slot. The machine's other two slots are filled with a color graphics board and a combination parallel and serial board, both installed at the factory. The disk controller circuitry is located on the motherboard, which lies flat on the bottom of the system unit. You can buy the

The fanless TeleVideo TPC II

system with one or two half-height 360K 5¼-inch floppy disk drives, mounted vertically on the right side of the unit.

You may well discover that having one empty slot is three or four short of ideal. Although multifunction boards are increasing in power and capabilities, no single expansion board can cover all application bases.

The TPC-II's ergonomically correct 9-inch monitor is integrated into the center of the cabinet; a brightness-control knob is located to the left of the display. The TPC-II lacks a carrying case, but the plastic case is rugged and includes a handle that folds flat into the chassis.

The yellow phosphor screen provides the standard 80 characters by 25 lines and, like the Compaq and IBM Portable, supports graphics. Any program requiring a color graphics board can be run on the TPC-II. However, unlike the Compaq, the TPC-II does not support dual-mode operation, so it cannot emulate the finer resolution of the PC's monochrome display. The 640- by 200-pixel resolution is identical to that of IBM's Portable PC.

The keyboard layout is the same as the PC's, but the keys are slightly larger, so you cannot use standard plastic keyboard templates. The feel of the lightweight keyboard is slightly mushy, but TeleVideo is reportedly planning to correct the problem and provide an even, spring-pressure action. Although key layout resembles the PC's, the <Ins> key is oversize, increasing the likelihood of inadvertently flicking the insert mode on or off (with potentially unpleasant results) when you attempt to strike the <Del> key. The detachable keyboard is plugged into the back of the computer with a modular phone jack connector.

It's the TPC-II's ventilation system that sets it apart from the compatibles crowd. Normally, when you turn a computer on, you hear a fan that hums like an out-of-tune Chevy. Turning on the TPC-II, however, elicits no sound at all—the TPC-II contains no fan. The system is ventilated by ambient air circulating within the room.

Such a fanless computer would be impossible without the help of the VLSI (very large scale integration) chips used throughout the system. By packing more power into a single chip, VLSI technology allows a manufacturer to get by with fewer chips; the computer, therefore, emits less heat. The result is a fanless system and a quiet machine.

Although heat buildup was not a problem during brief periods of use, I found that prolonged bouts with the TPC-II did give me the willies about heat-related data errors. On several occasions I removed fairly warm disks from the machine—then left the TPC-II on as the disks returned to room temperature. I may well have erred on the side of caution; at no time was any data or program disk damaged.

The TPC-II comes with its own version of the MS-DOS 2.11 operating system, called Tele-DOS. The computer can also run under PC-DOS 1.10 and 2.00 with no problem.

The TPC-II is bundled with three software packages written for TeleVideo's 16-bit machines—*TeleWrite, TeleCalc,* and *Tele-*

DBMS. TeleWrite is more a memo writer than a full-fledged word processor; *TeleCalc* spreadsheets can contain only 99 columns and 256 rows. *TeleDBMS* is a filing system with limited ability to handle files, records, and characters. Although none of these packages is full-featured, all provide a purchasing incentive to the first-time computer user because they introduce commonly used applications.

Software compatibility with the PC is solid. My library of IBM PC software exceeds 75 packages, and the TPC-II didn't reject a single floppy I inserted. Among the packages tested were *1-2-3, VisiCalc, dBASE II, WordStar, ProKey, Multimate, TK!Solver, Time Manager,* and the *pfs:* family of software. All program commands were accessible in a fashion similar to the PC's and worked at comparable speeds. The TPC-II ran Microsoft's *Flight Simulator*—the PC compatibility acid test—with ease.

One exception to compatibility is BASIC. The TPC-II comes equipped with GW BASIC, so some programs written in IBM BASIC may require minor changes to be fully compatible with the TPC-II.

The only hardware incompatibility I encountered was the machine's lack of support for an 8087 math coprocessor. That omission might put the TPC-II off-limits to engineers, scientists, and users interested in big number-crunching tasks.

Service on the TeleVideo line is provided by TRW Field Service Organization—and that should offer a measure of comfort in these admittedly rough times for compatibles manufacturers (TeleVideo's profits are down, due in part to sluggish sales of its PC work-alikes.)

If you're looking for a quiet, sturdy, highly compatible portable, and if you don't plan to add more than one expansion board, the TPC-II is worthy of your attention.—*Farid N. Ghadry*

Farid N. Ghadry is a microcomputer consultant in Vienna, Virginia.

Software

Downsizing Software for the One

Release a new machine with unconventional floppy disk drives, and no software vendor will beat a path to your door. Right?

Apparently not, if you're Data General and you're promoting the DG One, a PC-compatible lap-size that sports double-sided 3½-inch floppies. (The 720K 3½-inch disks are actually emerging as a "second standard," courtesy of support from Apple and Hewlett-Packard.)

Versions of nearly 70 top-selling software packages from 29 vendors are available for the DG One. And if the initial flurry of custom packages is any indication, the new machine should lead a productive life. The DG One's software library includes Ashton-Tate's *dBASE II* and *Friday!*; Software Publishing's *pfs:* family; Lotus Development's *1-2-3* and *Symphony;* MicroPro's *WordStar;* Microsoft's *Multiplan, Word,* and GW BASIC; Autodesk's *Auto CAD;* Sorcim/IUS's *SuperCalc 3;* Microstuf's *Crosstalk;* Software Arts' *TK!Solver;* IUS's *Easywriter II;* Living Videotext's *ThinkTank;* and Harvard Software's *Harvard Project Manager.*

The DG One features a CMOS 8088 CPU and a full-screen, 25-line liquid crystal display. The machine lists for $2895.

The Seal of Compatibility

For the average business, testing off-the-shelf PC software on purported compatibles isn't a tantalizing proposition. Even if you could get your hands on a worthwhile fraction of the 8500 PC packages on the market, performing tests is a logistical (and financial) nightmare.

Enter Softeam, a southern California software distributor that evaluates and certifies the compatibility of PC software on new PC work-alikes.

AT&T recently retained Softeam to beat on its PC 6300, and the Italian-made 8086-based machine emerged looking mighty PC compatible. Of the reported 550 packages Softeam tested, the PC 6300 handled 80 percent (including the hits from Lotus, Ashton-Tate, and Microsoft) without a murmur. The remaining 20 per-

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Ask about **ZeroDisk** to run copy-protected software from a hard disk.

cent tend to rely on hardware-dependent routines that bypass the operating system.

Accordingly, AT&T plans to squeeze the remaining vestiges of incompatibility from the 6300. The company is revising the machine's ROM BIOS (basic input/output system) to minimize differences with the PC. Published reports say that AT&T will upgrade ROMs in existing machines at no charge.

Nothing sells like a seal of approval, which may be why Polo Microsystems has also asked Softeam to test more than 100 packages—including Polo's own bundled software—for compatibility with its Polo Personal Computer System. The Polo PC features dual 80188 and Z80 microprocessors.

New Editor for Rainbow

UniPress Software has released its *Gosling EMACS* screen editor for the DEC Rainbow 100+, the hard disk version of the Rainbow.

EMACS includes full-screen editing, multiple windows, extensive macro capabilities, full search and replace commands, and a compiled version of the MLISP programming language.

Erratum

Wang Laboratories developed new PC emulation software for its Professional Computer internally and did not rely on Phoenix Software Associates for the product, as originally reported in *Compatibles Update, PCW,* Vol. 2, No. 12. *Compatibles Update* regrets the error.

TPC-II
TeleVideo Systems, Inc.
1170 Morse Ave.
Sunnyvale, CA 94086
408/745-7760
List price: TPC-IIS (one disk drive) $2095, TPC-IID (two disk drives) $2395

Compatibles Update welcomes contributions from readers, and we'll pay up to $50 for the items we use. Please include your name, address, and phone number with your contribution. Send it to Compatibles Update, PC World, *555 De Haro St., San Francisco, CA 94107.*

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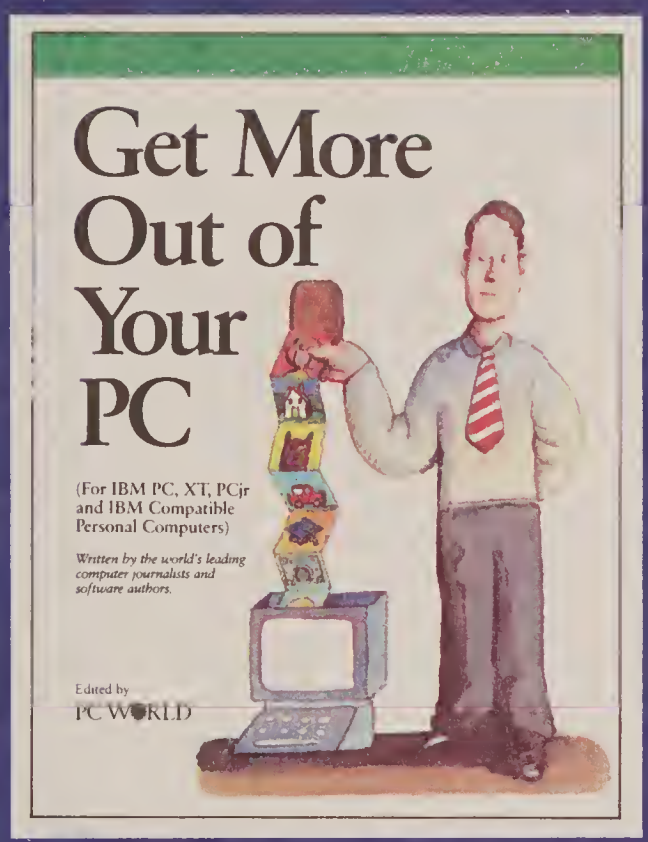

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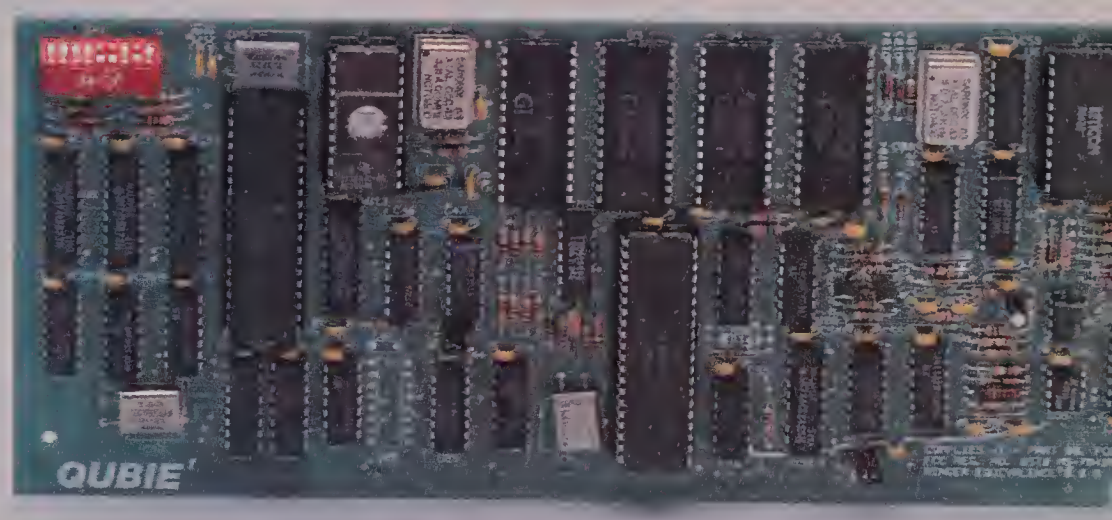

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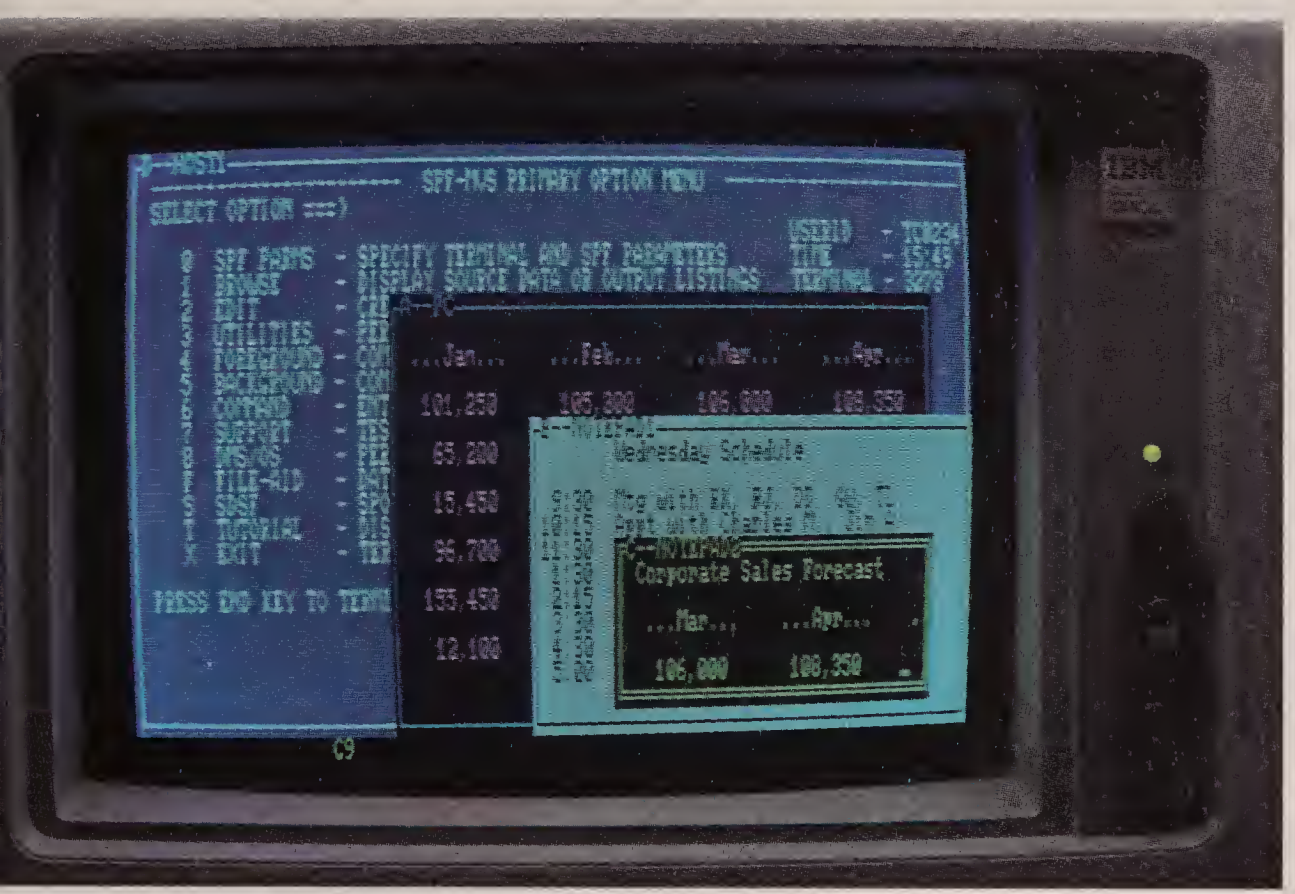

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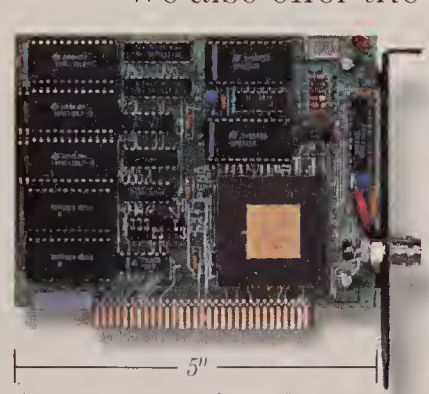

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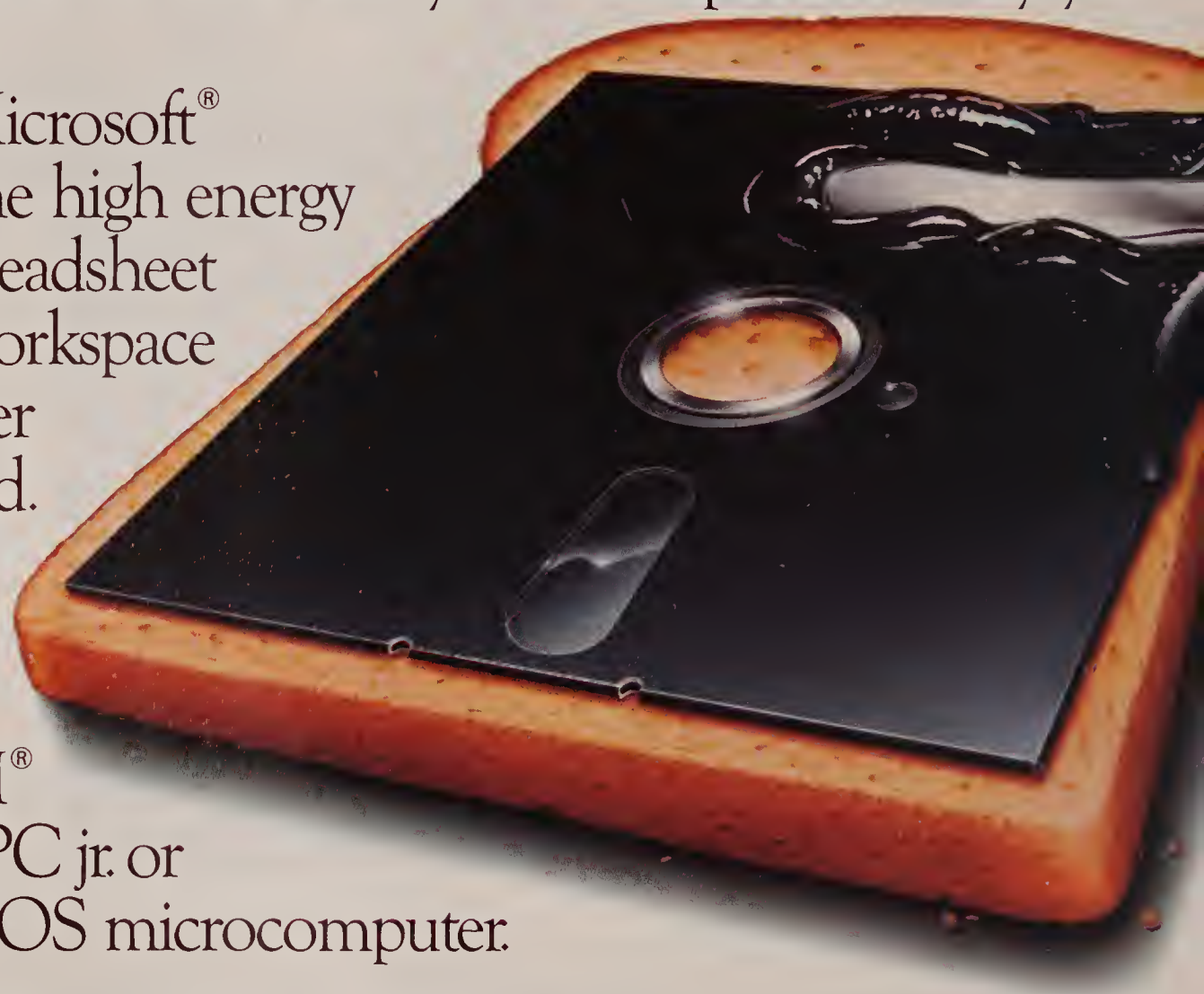

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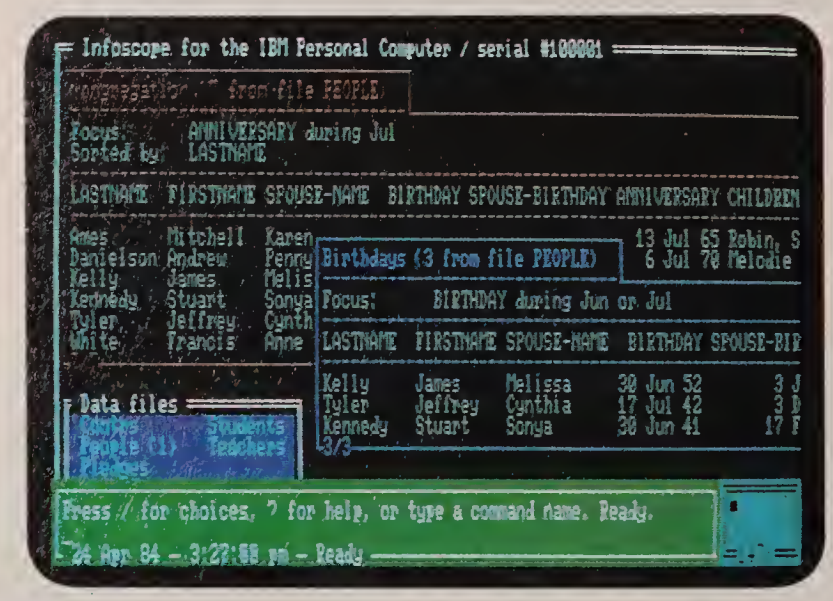

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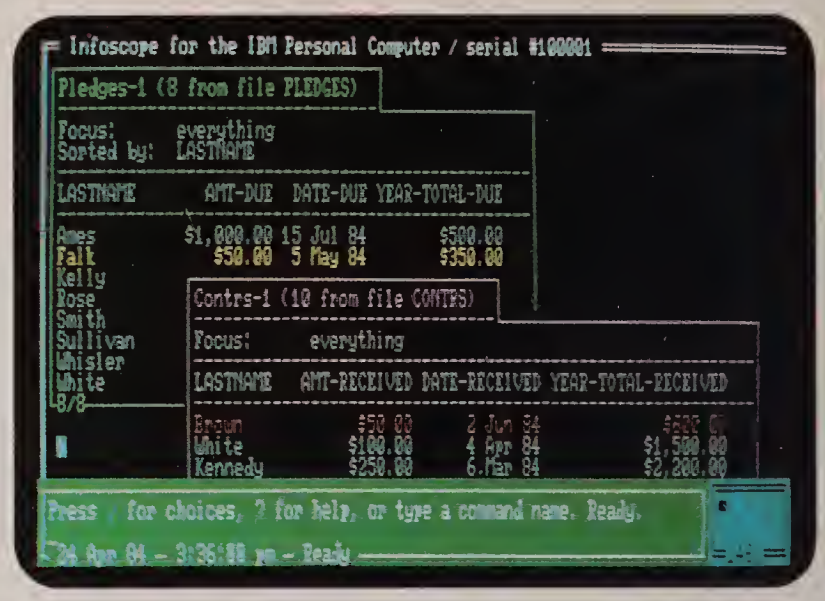

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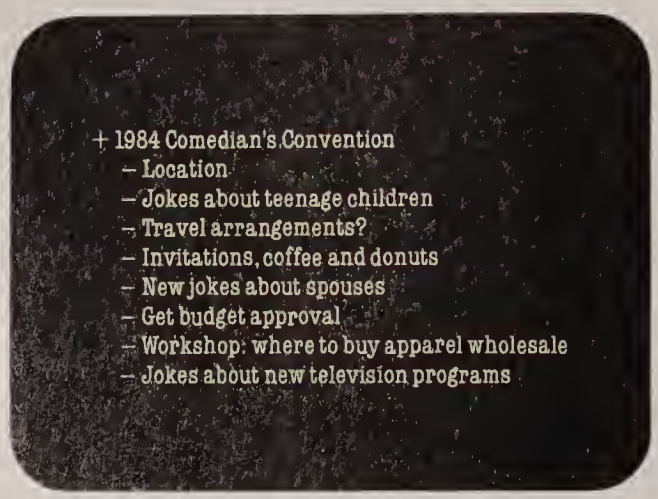

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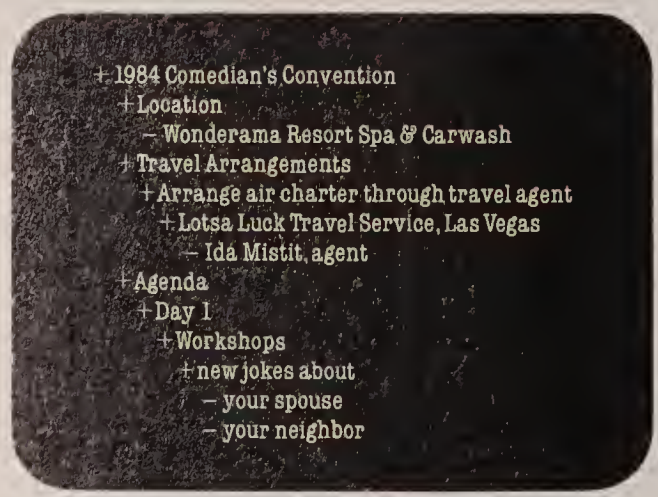

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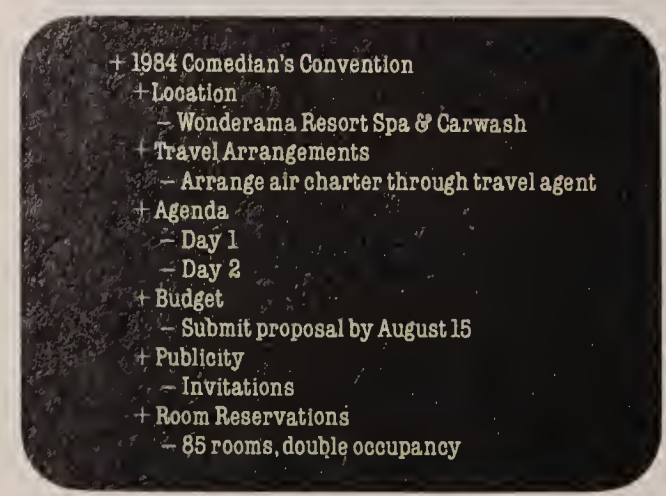

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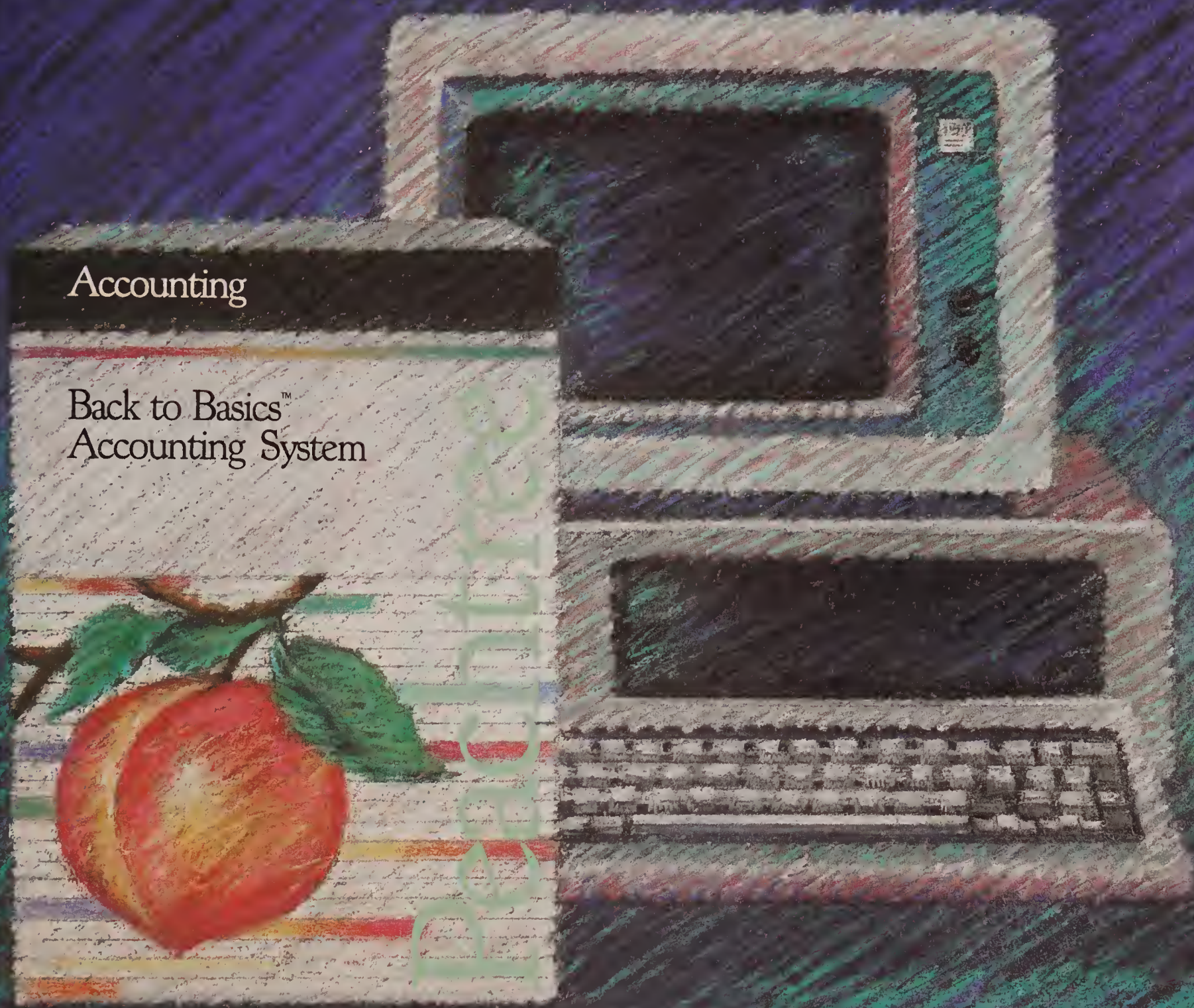

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Six Leading LANs

Culling the major contenders from the crowded local area network field, PC World assesses how well the top half-dozen LANs fulfill the promise of effective, efficient data and resource sharing.

Jonathan Sachs

Networks for the PC have come of age. Spurred by the need to share hardware, software, and data, local area networks (LANs) may well take off in 1985. With the release of its broadband PC Network (see "AT: The PC's Powerful Partner," *PCW*, Vol. 2, No. 13), IBM has conferred needed legitimacy on local networking, an area of personal computing that has until recently suffered from a lack of discernible hardware standards and appropriate software.

The networks reviewed here–Novell's Netware/S-Net, 3Com's EtherSeries, Nestar's PLAN 3000, Orchid Technology's PCnet, Corvus Systems' Omninet, and Ungermann-Bass's Net/One–are primarily entry-level offerings from six veteran firms in the network business. The specific network products were selected because each manufacturer is an experienced player in the LAN market, each designed its product for the PC, and each has an installed base of networks (see "Local Area Networks," *PCW*, Vol. 2, No. 7).

Methodology

Testing a local area network is more complicated than checking out a disk drive or a spreadsheet program. LANs are used in office environments in which several people perform related tasks with different computers. By their very nature, LANs increase the number of places at which work can be done; this dispersion also increases the complexity of the test environment and can make interpreting test results difficult.

PC World did its network testing in conjunction with Micro MRP, a Foster City, California, firm that develops manufacturing software for personal computers. Micro MRP installed each LAN product on its own complement of PCs.

Micro MRP initially tested each LAN in a minimal configuration that consisted of a server (the network's traffic cop and repository of shared data) and one user station. Only when this two-station configuration worked did Micro MRP staff bring the LAN up to a total of five stations (the standard for testing purposes). This strategy made dealing with unfamiliar technical problems somewhat easier than

Table 1: Overall evaluation of local area network characteristics

	Netware/S-Net Novell, Inc.	EtherSeries 3Com Corp.	Omninet Corvus Systems, Inc.
Installation	Easy; cables are bulky	Fairly easy; extra care needed	Easiest
System manager experience required	Some network experience	No special qualifications	No special qualifications
Ease of operation	System is transparent at DOS level	System is transparent at DOS level	System is transparent at DOS level
Level of resource locking	Record locking	File locking	File locking
Security	Logon with name and password	Logon with name and password	Logon with name and password
Quality of technical support	Superior; staff helpful	Superior; staff helpful	Good; staff helpful
Documentation	Excellent	Good	Excellent

moving to full implementation immediately. (It is a prudent approach for any new network user, according to Gordon Haberfelde, Micro MRP's founder and technical director.)

Evaluation Criteria

Micro MRP installed *MAX–The Production Manager,* its materials resources planning package (see "Hard Disk Roundup," *PCW,* Vol. 1, No. 6), on each network's server and measured the time required to load and start the program from a user station when the network was otherwise idle. With the server freed from mediating among PCs vying for its resources, it was possible to obtain a reliable indication of the speed at which the LAN could move data from the server's hard disk to a user station.

The evaluation team eschewed speed tests or benchmarks, on the theory that such quantitative measures tend to be arbitrary and do not provide a realistic guide to LAN functionality (see "Untangling Networks" in this issue). Instead, Micro MRP's programmers tested each LAN under "loaded" working conditions, which encompassed software development chores during a period of several days ("loaded conditions" refers to disk-intensive–or, more generally, input/output-intensive–activity by multiple users). These chores involved a mix of text editing (similar to common word processing), compiling and linking programs (involving extensive computation but relatively little disk access), and software testing (akin to the actual operation of a data management application such as *MAX*). Micro MRP staff member Michael Hammond recorded impressions of each LAN's performance and conveyed opinions on why each LAN performed as it did.

In addition to measuring network performance in loaded and unloaded situations, Micro MRP also evaluated each LAN according to a range of variables: overall network design, implementation of file-access and file-protection schemes (with particular emphasis on how the LAN treats simultaneous updates of hard-disk-based data), ease of hardware and software installation, ease of operation, quality of documentation, and level of vendor support (see Table 1).

PLAN 3000 Nestar Systems, Inc.	PCnet Orchid Technology	Net/One Ungermann-Bass, Inc.
Easiest; software is hard to install	Very easy	Easy, but many interconnections
Extensive computer experience	None; most DOS-like network	Some network experience
System is transparent at DOS level	System is transparent at DOS level	System is transparent at DOS level
File locking	File locking	File locking
No logon; controlled by system manager	No sign-on security; private volumes assigned; physical installation	Logon with name and password
Minimal	Good; staff helpful	Good; staff helpful
Poor; too complicated	Very good	Excellent

General Findings

All networks reviewed here share certain characteristics. All have one or more servers to facilitate data sharing. A server usually is a computer with a hard disk of 10MB or greater. A file server is the specific device that handles reading and writing of files to that hard disk. (Technically, only the Novell S-Net hard disk is a true file server; the other five network vendors offer disk servers. A true file server regulates access to files for network users; a disk server offers users a shared hard disk but minimal file or record protection.) In practice a server may be a PC (such as an XT or an AT), a separate microprocessor for input/output tasks only, or a combination microprocessor and disk drive housed in a single unit. A file server handles input/output calls from all users on the network; accordingly, when a user loads a file, he or she is asking the server to access that file and send a copy to the user's PC. (In this article the individual PC is usually referred to as a *work station*. In technical terms any device on the network—PC or peripheral—is considered a *node*.)

For testing, each work station was equipped with a network interface board, which communicates with the network much as a disk controller board communicates with a disk drive. Servers and work stations were linked by cable, which is usually either bundled coaxial or a twisted pair of copper wires. Twisted-pair cable is inexpensive and easy to handle but has less capacity for high-speed transmissions than does coaxial cable. Coaxial cable can support multiple signals simultaneously, including voice and video as well as data. Regardless of the type of media, long-distance transmissions require that *repeaters*, or signal boosters, be used at periodic intervals. Even with repeaters, however, delays in transmission may be unacceptable for some users.

All networks place certain restrictions on application programs and the DOS operating system. For example, FORMAT is off-limits for network operations, although all the network operating systems tested include a utility that replaces the offending DOS command.

In each LAN, the server's hard disk can be partitioned into *directories* or *volumes*. Five of the six networks accept volumes of any size and in any quantity but require that volume size be determined before

the hard disk is partitioned (thus setting aside space to be used). Once volumes are determined, moreover, volume size cannot easily be changed. This disk-partitioning process can affect network performance; an abundance of small volumes, for example, generally retards network speed. Precisely because of the way DOS treats fragments on a hard disk, however, Micro MRP deemed the potential for performance problems a consequence of DOS rather than an inherent flaw in any network.

The notable exception to this partitioning method is Novell's operating system, which departs from DOS formatting conventions and allocates disk space on a sector-by-sector, as-needed basis.

All the network operating systems tested offer some form of file protection in a shared data environment. While the various LANs reflect different approaches to maintaining data integrity—and make different assumptions about the typical user's level of expertise—all let users know (to a greater or lesser degree) that a locking scheme is in place.

Installing hardware for any LAN can be complicated by nontechnical factors such as the lack of an appropriate place to lay cable. Software installation generally proved to be a trickier assignment than putting the hardware together.

Most of the network operating systems contain built-in file-locking schemes that permit, if not encourage, application developers to write custom software for the network. In most instances, nets support *logical locks* (also known as *semaphore locks*) capable of obtaining exclusive control of almost any resource.

Micro MRP found that file locking can have a predictable impact on network performance. When a lock is invoked on a file and an application program begins a large sort, for example, other application programs on the net may be left out in the cold.

Micro MRP judged all systems to be physically easy to install, although installing hardware for any LAN can be complicated by nontechnical factors such as the lack of an appropriate place to lay cable. Software installation generally proved to be a trickier assignment than putting the hardware together. The descriptions here discuss installation only in situations that Micro MRP deemed noteworthy.

Unlike personal computers, LANs cannot be maintained solely by casual users. All the networks discussed here require care and feeding by an individual with reasonable technical proficiency who serves as system administrator. The administrator performs tasks such as assigning user names and passwords, backing up the shared disk, and resolving operational problems. The job is likely to be full-time while the network is being broken in, but responsibilities and time demands may diminish once the LAN is up and running. Micro MRP generally found the level of technical support among vendors to be quite high, with 3Com leading the pack, Orchid Technology and Ungermann-Bass right behind, and Corvus only slightly less helpful. Alone among the companies surveyed, Nestar Systems failed to supply constructive technical assistance.

Although the six local area networks have much in common, most have distinct definitions of the term *local*. Maximum distances between nodes are as follows: Novell 3000 feet, Corvus 2000 feet, 3Com 3000 feet, and Orchid 7000 feet. Ungermann-Bass offers remote "bridges" for short and indeterminate distances, and Nestar claims a 2000-foot maximum between stations (see Table 2). Note that distances are not as the crow flies but based on the length of the cable (which can easily be double or triple the actual distance between machines). In a practical sense most of the LANs tend to be confined to a single building or, more commonly, to a single floor.

Novell Netware/S-Net

Novell takes an unusual approach to the LAN market: it sells its operating system software for use on other networks in addition to its own. The strategy indicates that Novell has a good deal of confidence in the software, which the company calls Netware. (Indeed, Novell's licensing agreements with other vendors continue to multiply, suggesting that Netware may one day be to networks what Microsoft's MS-DOS is to stand-alone PCs.) Based on

Novell's Netware/S-Net proprietary server, based on Motorola's 68000 microprocessor

Micro MRP's tests, Novell's confidence is justified. S-Net was judged the most powerful and flexible of any system tested.

With S-Net Novell has produced a well-designed, smooth-running network, perhaps the best of its kind on the market today. It is the product of choice for users who need its high performance and can afford its relatively high price. (If price is a major issue, you may want to look into Netware/G-Net, a budget version of the product that relies on a PC XT as both server and work station.)

Novell's S-Net uses a proprietary server with a Motorola 68000 CPU and an unusually fast hard disk. S-Net is designed for a medium-size installation of up to 24 users who put a premium on excellent response and data integrity.

Like most LANs, Netware/S-Net enables the server's hard disk to be divided into several directories that appear to users to be smaller, independent hard disks. Directories are defined from the server's console, presumably by a system manager (who authorizes access to the system by assigning passwords and allowing read-only or read/write access to various directories).

Unlike most networks, however, Novell's offers a true file server configuration. In this case PCs can intercept an application program's request to the server's hard disk at the level on which the stations open, read, and close files (rather than the level on which they read and write to various physical locations on the disk). Accordingly, the network "knows" when a program is opening a particular file and can bar a second user if the file is already in use. This is a more secure method than the typical disk server approach, which must depend to some extent on protection included in the application program—and on users who "play by the rules" by always accessing files through mechanisms that the network understands.

The Novell approach minimizes the consequences of two users attempting to update the same data simultaneously. If both try to write to the same disk at the same time (in Novell's terminology, to the same directory), the system must coordinate their operations so that the same disk space, for example, is not allocated to two different files. Netware does this automatically.

Under Netware the S-Net server allocates disk sectors in response to work station requests—a process made possible by Novell's thorough revision of DOS. The other five networks use what is essentially unmodified DOS and leave disk sectoring to each work station, whether or not other users are contending for the same sectors. To minimize conflicts, the other nets assign volumes to work stations and take care of sectors only within a volume. Netware keeps track of sectors on the hard disk, eliminating unused disk space, bolstering performance, and deflecting conflicts.

More subtly, if two programs try to write or modify data in the same file, the LAN must prevent them from getting in each other's way. Netware does this by locking all other programs out of a file while one program is working with it. Individual files can be assigned any of four attributes (read only, read/write, shareable, and nonshareable) that determine lock status. Netware features four levels of locking: automatic, manual, transaction, and record. The net even allows multiple locks on the same record.

Novell's locking system does not kid around. An initial attempt to write to a locked file simply won't work. Netware responds to conflicts by waiting or issuing an error message. (If you enter an "ignore" response to the error message, however, the system will take you at your word and write over the locked file.) The result is that multiuser application programs written to run under Netware can make system calls that lock individual records, enabling several users to successfully update the same file without corrupting data.

Table 2: Local area network characteristics

	Netware/S-Net Novell, Inc.	EtherSeries 3Com Corp.	Ominet Corvus Systems, Inc.
Configuration	Star	Bus	Bus
Maximum number of nodes	24	1000	64
Practical number of users	1 to 24	1 to 10	1 to 10
Protocol	Proprietary, polled differential line	CSMA/CD (EtherNet)	CSMA/CA
Bandwidth	Baseband, 600 kilobits per second per line	Baseband, 10 megabits per second	Baseband, 1 megabit per second
Cable	Double twisted pair	Coaxial	Twisted pair
Range	3000 feet server to each user	1000 feet per segment with thin coaxial, 3280 feet with thick coaxial, 2.5 kilometers with repeaters	1000 feet end to end, 4000 feet if sections linked with repeaters
Server	Proprietary server based on 68000 processor	Proprietary server based on 8086 or PC, PC XT, or PC AT	OmniDrive (disk server), optional utility server for peripherals
Work station computers	PC compatibles; TI Professional; Apple II, IIe; DEC Rainbow	PC compatibles, HP 150, TI	PC compatibles; PCjr; Apple II, IIe, III; DEC Rainbow; Zenith; Corvus Concept; Macintosh
Work station hardware	Interface board	Interface board; connector with thin coaxial, transceiver with thick coaxial	Interface board, "tap" clamped onto cable
Disk features	Up to 500MB, all shared files on server	30MB storage per drive, up to 15 drives on a server	5MB to 126MB
Security features	Limited access to subdirectories and volumes; file and record locking	Automatic volume locking; programs must lock files and records; password volume protection	Read-only or read/write access; volume locking program must lock files and records

continues

PLAN 3000 Nestar Systems, Inc.	PCnet Orchid Technology	Net/One Ungermann-Bass, Inc.
Bus (arbitrary tree)	Bus	Bus (fiber-optic version uses modified star)
255	255	2400, infinite with repeaters or bridges
1 to 10	1 to 5	1 to 5
Token passing (ArcNet)	CSMA/CD	CSMA/CD or CSMA
Baseband, 2.5 megabits per second	Baseband, 1 megabit per second	Baseband, 10 megabits per second; broadband, 5 megabits per second
Thin coaxial	Coaxial	Thin coaxial or fiber optic (also thick coaxial)
Up to 2000 feet between stations, 22,000 feet between hubs	7000 feet end to end (thin to 3000 feet)	Coaxial 1500 meters between stations, fiber optic 2800 meters between stations (broadband 10 miles)
Proprietary; print server is a PC compatible or an Apple II	IBM PC, PC XT, PC AT, or compatible with interface board	PC XT or compatible with interface unit or Davong
PC compatibles; Apple II, IIe, III	PC compatibles	PC compatibles, AT&T, Zenith
Interface board, connector	Interface board, connector	Interface board, transceiver, transceiver cable (on broadband 5MB modem)
24MB to 56MB of disk storage; all shared storage is on file server; several file servers allowed on a network	Any node can be used as a server and run applications at the same time	Any node can be used as a server and run applications at the same time
Two levels of passwords; volume locking; programs must lock files and records	Automatic volume locking; lock files with DOS commands; public and private volumes	Volumes may be private or shared; I/O on shared volumes is substantially slower; password volume protection

Table 2 *(continued)*

	Netware/S-Net Novell, Inc.	EtherSeries 3Com Corp.	Ominet Corvus Systems, Inc.
Print features	Up to five printers on server; spooling	Optional print server supports two printers	Up to one parallel and two serial printers on utility server
Backup	Hard or floppy disk or tape	Disk or tape	On disk with DOS, on Corvus Mirror with network utilities, random access backup with 200MB bank
Features			
Electronic mail	Yes	Yes	Yes
Links to other networks	Yes	–	–
Gateways	–	Asynchronous and 3270	–
Other	Runs DOS 3.00 and 3.10 programs	–	Boots PCs from server
Price			
Interface board	$250, LAN board (for six users) $1995	$795 with software	$495, tap $10
Server	$5005; 512K RAM $1995; disk drive for server: 20MB $3995, 45MB $5495, 62MB $7695	$12,995	OmniDrive 5MB $1995, 16MB $3195, 45MB $4995; utility server $990; bank $2195
Transceiver	N/A	Thick coaxial $450	N/A
Software	N/A	PC server $595; print server $500; network server: EtherShare $795, EtherPrint $750	N/A
Link to IBM PC Network	Yes	–	Yes

PLAN 3000 Nestar Systems, Inc.	PCnet Orchid Technology	Net/One Ungermann-Bass, Inc.
Up to one parallel and two serial printers on print server; several print servers can be used	Any nodes can be used as print servers	Any nodes can be used as print servers
Tape drive built into file server	Disk backup with DOS command	Disk backup with DOS command
Yes	–	Yes
Yes	–	Yes
3270 and SNA	–	–
RAM disk; disk caching; "chat" facility; ROM for diskless boot	–	–
$595, connector $2.50 to $5	$495, with RAM $595, Blossom $795	With processor $1095, controller $595, controller with transceiver $750
$1995 to $14,995	N/A	N/A
Hub $75 to $1095 (fiber optic $250 per port)	N/A	$395, cable $50, optical transceiver $2100, broadband modem board $650
N/A	With cable $100	N/A
Yes	Yes	–

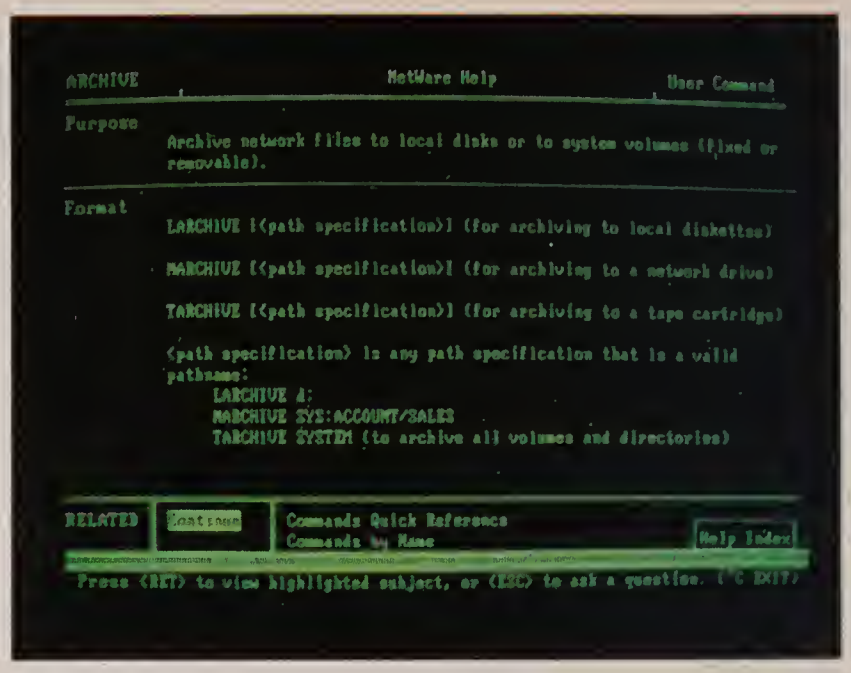
Netware has an unusually complete set of commands for manipulating directories and files. You can enter the NPATH command to link a given directory to one of your station's drive names, such as B:, C:, or D: (as long as you are authorized to use that directory). Other commands enable you to list, copy, rename, and control directory access by other users. These commands replace such DOS commands as CHDIR, PATH, and DISKCOPY, which are invalid or inappropriate on Netware/S-Net directories.

The VIEW command enables you to scroll through a text file without a text editor. Micro MRP found this an efficient alternative to loading a text editor and retrieving the file. It is typical of the thoroughness with which Novell designed its software.

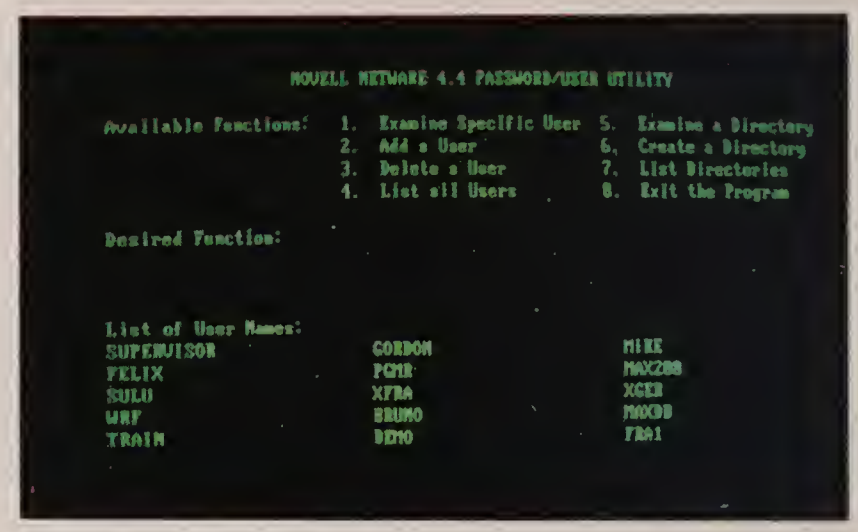
On the hardware side S-Net performed very well in Micro MRP's tests. Novell's high-speed hard disk responded quickly in single-user situations. That solid performance was not significantly impaired when several users competed for the server's attention.

The system's good showing may be due in part to its star configuration, in which each user's station is connected directly to the server (see "Strategies for Sharing Resources" and "Untangling Networks" in this issue). Most of the other LANs tested use a bus configuration, in which the server and every PC share a single cable. A bus carries a message between the server and a single station at a time, while a star can theoretically carry simultaneous messages between the server and every user. Novell's top-notch performance demonstrates how misleading published data transfer rates can be; S-Net checks out with a relatively sluggish transmission rate of 450 kilobits per second, although the actual throughput is greater than 3Com's 10-megabit system.

The Novell LAN derives its speed from the marriage of a 32-bit 68000 microprocessor (managing all input/output tasks) to an efficient network operating system. Credit goes to Netware's optional server *caching* feature (see discussion of disk caching under PCnet) and *elevator-seeking* disk head movement (so-called because the disk drive's read/write head moves logically across the disk, not in response to the order of requests).



This NetWare help screen enables users to move files to a local floppy disk, a network file server, or a tape backup unit.



From this NetWare utility, the system manager can define levels of security for various network users.

The S-Net documentation also received high marks. A written tutorial leads the system manager through the installation process with a minimum of pain. The rest of the documentation assumes moderate familiarity with DOS, including such concepts as subdirectories and disk backup, but it is well organized and clearly written. One notable omission from the manual is an index. On-line help consists of a series of menus and screens that thoroughly cover console commands, user commands, and system utilities—in all, a good means of acclimating beginners to Netware/S-Net.

Corvus Omninet

Corvus gained its reputation as a manufacturer of hard disks and other mass storage devices for the first crop of Apple II computers. Not surprisingly, Omninet, the company's local area network offering, is noteworthy for the way its hard disk server accepts a variety of operating system formats. Omninet is a solid, middle-of-the-road LAN that provides reasonable performance and an adequate range of features at a moderate price.

Omninet supports three kinds of nodes: users, file servers (which provide shareable disk storage), and utility servers (input/output processors that allow the sharing of printers and similar devices). The proprietary OmniDrive server is essentially a microcomputer with a hard disk and a network interface board but without a keyboard or a monitor. The utility server is similarly configured.

Omninet uses a bus structure consisting of a single inexpensive twisted-pair cable that runs through each server and each work station. A station is connected to the cable with a *tap*, a small box that clamps around the cable and makes electrical contact at a point stripped of insulation. A short tap cable connects the station to its tap. Both its simple cable and its straightforward software made Omninet the easiest LAN of the lot to install.

The Corvus Omninet Utility Server, which handles tasks for peripherals, sits atop the Corvus OmniDrive disk server.

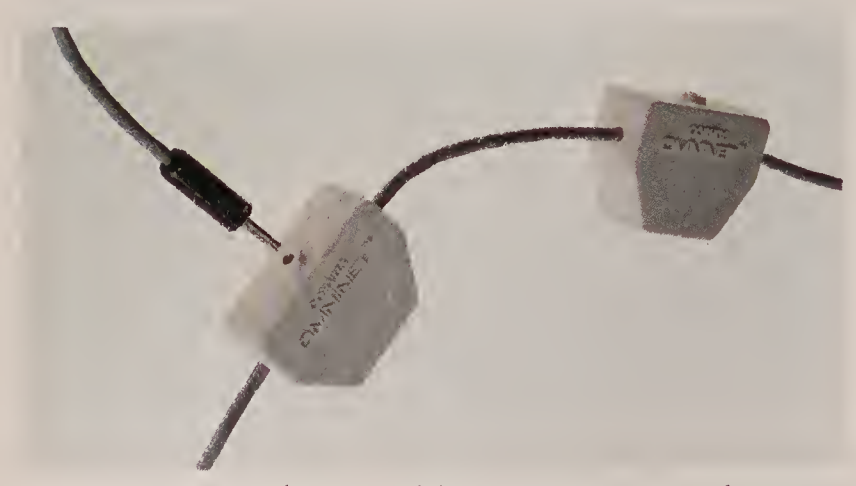
The Omninet opening menu. From this screen, the system manager can set volume size and determine user access levels.

Omninet's hard disk is divided into "volumes" that are analogous to Netware directories. The system manager creates volumes and distributes access rights (including passwords) to them; each user then selects the volume to link with the specific drive name.

Each volume can support a different operating system format (such as PC-DOS, Apple DOS, or CP/M), hence the name *Omninet*. This feature enables Omninet to link a diverse mix of work station computers, all of which can use space on the same hard disk. Omninet software, however, does not allow different kinds of computers to share a single volume.

Omninet software includes features that are helpful in a networked environment, such as password-controlled access to work stations, the provision for users to "mount" volumes on drive names, and commands for linking volumes to drive names. Much of the software is menu-driven, which is a boon for beginners but may be a slight impediment for more experienced users.

Omninet commands to prevent multiuser operations from damaging data are fairly primitive. On an administration level the chief protection is the system manager's ability to grant users different kinds of access to a volume. In software, volume access is controlled by two menu-driven programs: the volume manager and the access manager. One user might receive private or read/write access to a volume; all other users would have read-only access to that volume. Only a user with the right "private" password



Omninet twisted-pair cabling. Users can "plug in" to the system via a series of keystone-shaped "taps" placed at various intervals on the line.

could then modify the file. Clearly, if each user has authority to write to his or her volume only, concurrent update problems cannot arise. Similarly, each volume can be protected from unauthorized inspection by limiting read-only access to authorized users.

The file-security options available to programmers are more extensive than those for general users, which may be one way that Corvus is encouraging application development for its LAN. Programs can be written to lock volumes, files, or individual records.

Omninet performed satisfactorily in Micro MRP's speed tests. Response to operations that required transferring data through a lightly loaded network was fast, but response time lagged as the load (that is, the number of users and their network activity) increased. Performance was constrained by command-level menus, each of which runs a different program utility.

The evaluation team found Omninet documentation clear and well organized. That clarity helped the evaluation team become comfortable with the system fairly quickly. Like the Novell product, however, the Corvus manuals lack indexes.

Nestar PLAN 3000

Nestar's PLAN (Personal Local Area Network) 3000 is the middle entry in the company's trio of PC-based local area network products. PLAN 3000 is a highly capable system with sufficient—but not outstanding—file security and multiuser protection. Poor documentation mars an otherwise adequate product.

The PLAN 3000 proprietary file server is about the size of a PC. For print serving, the 3000 can use a PC, a PC compatible, or an Apple II. Under loaded conditions Nestar's LAN can effectively handle three to ten stations.

Nestar has endorsed a "hub" architecture as a means of extending the range and number of PLAN 3000 nodes. The network is organized around small interface devices known as hubs, each of which contains six ports (one input port—for another hub or a server—and five output ports for another hub or other work stations. Hubs can be connected to each other in any manner so long as none of the connections forms a closed loop. Unorthodox as this may sound, it resembles other coaxial-cable-based network extensions (some of which involve taps, transceivers, or, in the case of Ungermann-Bass's Net/One, multiple transceivers).

The coaxial cable that connects nodes and hubs is attached to each device by screw-in connectors. Coaxial cable costs more and is harder to connect than twisted-pair cable but offers the LAN faster data transmission and greater maximum distance.

If you buy cables cut to your specification and fitted with the necessary connectors, PLAN 3000 is simple to install. Nestar loads file server software at the factory, making hard disk setup quick and easy. On the other hand, PLAN 3000 includes a bit of overhead, requiring that you use Nestar-supplied routines before invoking file server commands in a program.

PLAN 3000's operating system enables users to create their own "virtual volumes" on the server's hard disk. A "real" volume is a floppy disk; a "real" drive is A: or B: (on a network, your local floppy disk drives). A virtual volume is a "pretend" floppy disk that you create on the network's hard disk. In practice, one user might "own" the first ten virtual volumes on a file server and then link them—as one real volume—to a particular drive.

The disk server for Nestar's PLAN 3000 bears a strong resemblance to the PC's system unit and features 24MB to 56MB of disk storage.

Because a virtual volume can be formatted like a floppy disk, it can be used with a variety of personal computer operating systems. This feature gives the Nestar system Omninet-like versatility, enabling PC-DOS or Apple DOS to access PLAN 3000's server. As with Omninet, you can grant other users access rights to virtual volumes that you own, but others must use the operating system for which the volume was created. Several access levels can be defined and protected by different passwords; by distributing passwords selectively, you can permit some users to write to the virtual volume while others can only read it.

To protect a virtual volume from data conflicts, you can ask the operating system for exclusive access when the volume is "mounted." If you fail to do this, each application program accessing the volume must lock the files or records that it uses in order to prevent a simultaneous update from destroying data. In practice, PLAN 3000's file-locking scheme ranked as the most complex of those considered here. Nestar's entire approach, for that matter, suggested an orientation toward a high-tech audience. Even technical support personnel were unresponsive to queries about network operation.

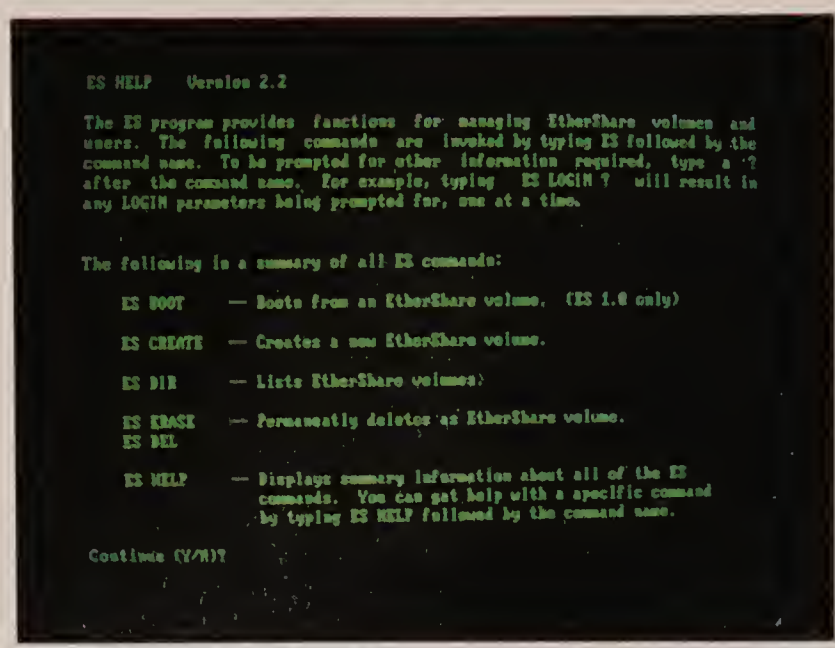
On input/output tests PLAN 3000 performed well. The major impediment to peak performance is the system's complexity. Once users become familiar with its intricacies, however, PLAN 3000 offers a great deal of power. The network seems ideally suited to supporting a large number of nodes or supporting nodes involved in applications (such as data management) that require a great deal of disk activity.

The Nestar documentation, however, is something less than a model of its genre and typifies the company's technical posture. Documentation consists of an assortment of manuals for a variety of purposes (ranging from file server installation to server management to work station operation). Manuals are poorly organized; key facts are buried in unlikely places—often in a manual seemingly unrelated to the product or the problem at hand. The package comes without a tutorial for novices. Accordingly, new users—whatever their level of expertise—are apt to wile away long and frustrating hours before Nestar's explanations begin to make sense. Nestar, to its credit, does include an index.

The Nestar hub. This general-purpose connector features six ports—five for output and one for input—and extends the range and number of PLAN 3000 nodes.

3Com EtherSeries

EtherSeries is the family name for a group of 3Com products that provide network capabilities for PCs and PC compatibles. EtherLink consists of a network interface board and a coaxial cable package to connect PCs. EtherShare is the operating system software package that turns a PC XT into a file server or operates a proprietary Altos/3Com server with a high-speed 30MB hard disk. (Micro MRP tested only the Altos server; note that using an XT as a server dedicates it to that task exclusively.) EtherPrint is a software package that enables the file server to function also as a print server. EtherMail is an optional electronic mail application.



The 3Com EtherSeries help screen includes functions for managing EtherShare volumes and traffic.

Micro MRP found EtherSeries to be an excellent choice for small to medium-size networks. Its straightforward design enhances the network's performance: EtherSeries is easier to learn and use than many of its competitors, and that simplicity tends to improve response time under actual working conditions.

Micro MRP's initial experience with EtherSeries was not auspicious, however. From the time of setup, technicians were bombarded with 'file server not ready' error messages. After inconclusively running a battery of diagnostic programs and placing several calls to 3Com, the testing crew returned all 3Com hardware. It took Steve Pomeroy, 3Com's sales support vice president, just a few moments to determine that the power pin in a transceiver cable was bent. The moral is that simple problems can jam a sophisticated network (and that the user must carefully scrutinize the merchandise for physical defects). If there's another lesson, it's that resolving technical problems can test a company's mettle. 3Com's technical support came through with flags flying.

EtherSeries, like other LANs designed around Xerox's Ethernet protocol, uses thin coaxial cable. (A thick coaxial cable is also available, but it can't simply be plugged into a PC; an additional box is required.) The Ethernet protocol moves data at 10 megabits per second, which is a good deal higher than any other product reviewed here. Since Ethernet calls for a bus configuration, however, this rapid transmission rate must be shared by all stations on the network. As in all bus networks, the effective data transfer speed diminishes as network traffic increases.

3Com seems to have given some thought to the differences in user sophistication. Most EtherSeries commands may be entered in either of two forms. Novices can rely on prompts that probe for network parameters; more experienced users can enter all data in a single command.

EtherSeries users create their own volumes on the file server's hard disk. A user can protect a volume by assigning passwords that other users must enter before accessing the volume. Volumes can be defined as public (allowing several users read-only access), private (allowing read/write access to one user at a time), or shared (allowing read/write access to several users). If a volume is to be shared, each application program must implement file- or record-locking mechanisms or risk damaging data or the volume directory.

Under loaded conditions EtherSeries offered faster response than every net but Novell S-Net. That speed is attributable to the LAN's Altos server and the Ethernet protocol. And because the 3Com net required relatively little effort to master, network users were able to derive peak performance from EtherSeries in short order. 3Com's approach to system growth is pragmatic (and potentially profitable): users are encouraged to load the network until performance becomes unsatisfactory. At that point—typically with six users—the company advises adding another server.

The Altos 586, the 8086-based proprietary server for 3Com's EtherSeries local area network

A 3Com transceiver. The transceiver translates the PC's digital signal into a frequency the network can understand.

Each EtherSeries product has its own manual. Manuals are compact and clear and include tutorial introductions to each product as well as reference descriptions of network commands. Each manual is indexed.

Orchid Technology PCnet

PCnet is a nonconformist in the LAN world, with a design different from most of the other LANs reviewed here. Orchid's network is primarily intended to link two or three stations. It offers fewer features and less flexibility than its peers but costs less and is simpler to use. Orchid Technology has licensed PCnet to AST Research and Santa Clara Systems, among others.

PCnet suggests "low end" on both price and performance. Its unusual philosophy and innovative design make it an attractive choice for any business interested in connecting a small number of PCs without spending a bundle.

Orchid's network interface is available as an expansion board or as a piggyback to the company's own multifunction board. That in itself is an option unique among the products tested. In a five-slot PC, PCnet's space-saving traits could mean having room to insert all the expansion boards you need.

Orchid Technology manufactures no file or print server hardware. PCnet is limited to one file server per network. Any or all stations on the net can function as print servers. Any PC (even one without a hard disk) attached to PCnet can function as both a file server and a work station. In such a dual-use situation (one in which the file server is also a work station), incoming network requests and local work station requests share CPU resources. Dual use tends to degrade the net's performance for all users.

As in other LANs, the server's hard disk can be divided into several volumes that users can associate with work station drive names. There is no provision for protecting volumes with passwords, nor are there equivalent forms of access control.

A volume can be designated as public (enabling several users to access it at once) or private (allowing one user to access it at a time). PCnet automatically protects a public volume's directory from damage due to simultaneous updates, but at a cost: disk operations are three to four times slower on public volumes than on private ones. PCnet contains commands to lock files on public volumes, and application programs can lock files or records by making appropriate system calls.

As with all nets but Novell's, the size of a private volume, once allocated, cannot be changed. In addition, because only one user can access a private volume, simultaneous updates do not occur.

PCnet performed well when network traffic was limited to a single user. But the net didn't take long to bog down when several users competed for system resources. This is a natural consequence of the system's design but could prove surprising to users anticipating performance equal to that of a $20,000 LAN.

In fact, Orchid Technology has demonstrated considerable imagination by enabling PCnet to function as well as it does given its limitations. A PCnet interface board, for example, can be equipped with a disk cache (similar to a RAM disk) that stores several sectors of disk data. When a work station reads data from the file server's hard disk, that sector and several others are automatically stored in the station's cache. If the station then reads one of the following sectors, the data is taken from the cache and skips the LAN entirely. In the case of a program's overlay file, this may mean reading data from the file server once instead of hundreds of times. The load on the server is reduced accordingly, and system performance increases.

Orchid's documentation is admirably clear. Its installation section makes effective use of screen shots and switch-setting diagrams. Inexperienced users are apt to find that PCnet offers the most accessible manual of the half-dozen networks.

Table 3: LAN software[1]

	Netware/S-Net Novell, Inc.[2]	EtherSeries 3Com Corp.	Omninet Corvus Systems, Inc.
Data management	Dataflex (Data Access)	LAN:DATACORE, LAN:DATASTORE (Software Connections)	Dataflex (Data Access)
	Informa (Unlimited Processing)	Multiuser dBASE II (Ashton-Tate)	Informa (Unlimited Processing)
	LAN:DATACORE, LAN:DATASTORE (Software Connections)	Probase (Data Technology, Inc.)	LAN:DATACORE, LAN:DATASTORE (Software Connections)
	Metafile (Sensor Based Systems)		Liaison (SofTech Microsystems)
	Optimum (Uveon)		Omnis (Organizational Software Corp.)
	Revelation (Cosmos)		TDM (Pascal Systems)
Accounting	General Business (CYMA)	Accounting System (Heritage Computing)	AccountMaster (Small Business Systems Group)
	Software Fitness Program (Open Systems)	Software Fitness Program (Open Systems)	Hardisk Accounting (Great Plains Accounting)
		Total Accounting System (TCS Software)	
Spreadsheet		VisiCalc (VisiCorp/3Com)	
Word processing		VisiWord (VisiCorp/3Com)	

[1]This is a partial list of application software that runs on the networks mentioned in the article. The programs can be copied to a shared network disk, use the network's locking protocols, and be run by multiple users. Multiple-use licensing fees vary by product. Note that many other programs, such as 1-2-3, can usually be run on the systems but in a single-user fashion.

[2]Novell provides a list of more than 500 programs that will run on its network.

[3]These five programs come bundled in Nestar's PLANPak software package with no licensing fee required.

Ungermann-Bass Net/One

Ungermann-Bass (U-B) is unique among the six manufacturers in the road it took to the PC-based LAN market. U-B began as a supplier not of personal computer products but of networks for mainframe computers, a market in which it remains a prominent player. Net/One is the company's first venture into the personal computer universe.

Net/One is nearer to PCnet in cost and capability than to its other counterparts in this review. Because it owns a smaller share of the market than the rest, Net/One has inspired relatively few multiuser application programs. On the other hand, its links to other U-B products make Net/One suitable for applications that involve long-distance network communications or links with large computers.

Net/One is also closer in design to Orchid Technology's PCnet than to the other four LANS that

PLAN 3000 Nestar Systems, Inc.[3]	PCnet Orchid Technology	Net/One Ungermann-Bass, Inc.
LAN:DATACORE, LAN:DATASTORE (Software Connections)	BOSS (American Planning Corp.)	Informa (Unlimited Processing)
MDBS III (Micro Data Base Systems)	Dataflex (Data Access)	LAN:DATACORE, LAN:DATASTORE (Software Connections)
Multiuser dBASE II (Ashton-Tate)	LAN:DATACORE, LAN:DATASTORE (Software Connections)	
Revelation (Cosmos)	Metafile (Sensor Based Systems)	
Quest Account (Quest, Inc.)		
SuperCalc (Sorcim/IUS)		
SuperCalc 3 (Sorcim/IUS)		
SuperWriter (Sorcim/IUS)		

Micro MRP tested. Like PCnet, Net/One is geared for businesses interested in implementing a modest-size network economically.

Ungermann-Bass does not offer a proprietary server but allows a PC XT or a similar computer to function as file or print server and work station simultaneously. Unlike PCnet, Net/One is not limited to a single file server; all PCs in a Net/One network can function as servers and work stations at the same time. Because of this ability to be configured in various ways, Net/One proved more flexible than PCnet.

The installation procedure for Net/One is unique: in most parts of the United States, Ungermann-Bass personnel will assemble the network for you, on site. This approach is evidence of Ungermann-Bass's traditional mainframe (and service) orientation. The firm generally sells direct rather than through retailers or distributors. And that's another indication that Net/One may be geared to corporate buyers interested in extending existing networks from big machines to desktops. Ungermann-Bass, on the other hand, claims it isn't shirking small business.

Net/One supports a variety of approaches to cabling. A fiber-optic cable provides immunity from electromagnetic interference and offers excellent security (wire taps are impossible). A broadband ver-

sion of the product transmits LAN traffic over thick, TV-size coaxial cable. Micro MRP tested a more conventional baseband cable system that relies on thin Ethernet coaxial cable.

Ungermann-Bass offers two kinds of "bridges" that can connect Net/One LANs to other U-B products. Both work over telephone lines; one is suitable for short distances (for example, between adjacent buildings), and the other is said to work over virtually any distance—a useful feature if your business has remote stations that require access to a single data source. Other U-B offerings can connect a Net/One system to a mainframe, either by cable or through a high-speed telephone link.

Net/One's disk organization is similar to PCnet's. File server volumes are created by a program that can (but need not) be reserved for use by a system manager. Volumes can be restricted to a single user at a time, or they can be shared. At system shutdown, a park command rests all read/write heads on nondata disk areas. Net/One's operating system supports file and record locking for application programs designed to use shared volumes.

Password protection is available for both user logon names and volumes. Volume passwords can reflect several levels of access, such as read/write or read only. An unusual "write-only" access level enables several users to separately write to a disk or a file but prohibits each from reading the contributions of the others. Net/One software includes Printshare print server capabilities and Mailshare electronic mail service. Local volumes for electronic mail can reside on any hard disk or local floppy disk drive.

Net/One is closer in design to Orchid Technology's PCnet than to the other four LANS that Micro MRP tested.

The Net/One interface board sports a powerful 80186 microprocessor that deftly handles network traffic. Despite the CPU's speed and efficiency, Net/One's overall performance was constrained by the XT's input/output limitations. That said, the Ungermann-Bass entry deported itself reasonably well, faring somewhat better than PCnet under similarly loaded conditions.

Ungermann-Bass's Net/One relies on a thin Ethernet coaxial cable (bottom); the transceiver cable at the top links the 3Com EtherSeries network with a transceiver.

Net/One documentation is easy to use but is marred by periodic bouts of awkward English. These syntactical lapses sometimes obscure the manual's meaning, which is even tougher to divine without an index. Because Ungermann-Bass handles installation, Net/One includes no written technical documentation.

An Informed Choice

All six networks reviewed here are serviceable means of linking personal computers. The six range from the elaborate (Netware/S-Net) to the austere (PCnet). Network reliability over time obviously can't be measured in a laboratory setting. Your business needs, work load, application packages, and office logistics will determine whether a local area network is an appropriate solution—and if so, which LAN best meets those needs.

On performance alone Novell's S-Net emerged from Micro MRP's evaluation as the undisputed champ, followed by 3Com's EtherSeries, Corvus's Omninet, and Nestar's PLAN 3000, in that order. Ungermann-Bass's Net/One and Orchid Technology's PCnet demonstrated relatively less capacity to perform well under loaded conditions.

But the price/performance ratio remains the underlying benchmark for a network purchase. Remember that hardware is not the most crucial network expense, merely the most visible. Local area nets are fundamentally software products. Operating system software makes them work; application programs make them meaningful (see Table 3).

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Jonathan Sachs is an independent consultant living in the San Francisco Bay Area who specializes in text-processing software development.

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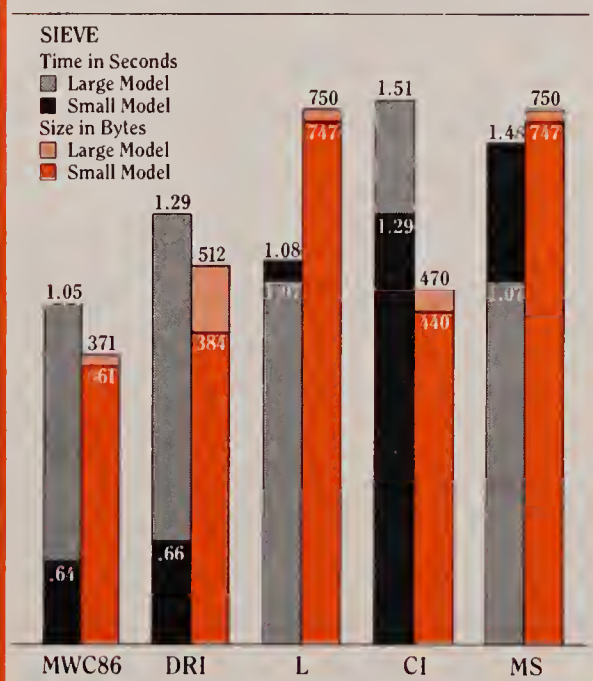

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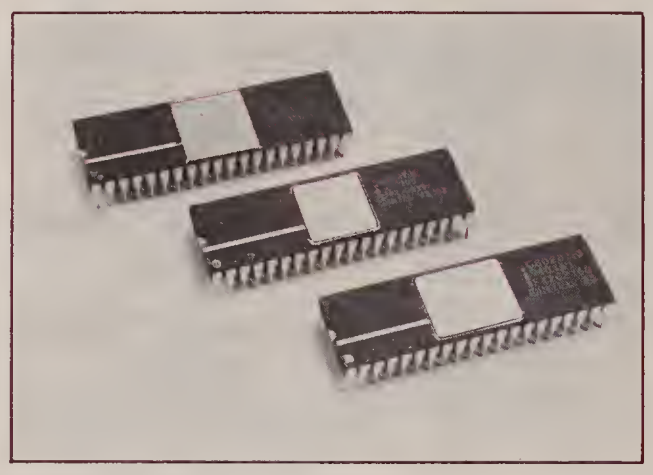

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The North Star Dimension, a multiuser computer supporting up to 12 work stations under a proprietary operating system compatible with the PC XT and MS-DOS 2.11

The Multiuser Dimension

Multiuser computers have been around a long time but are now attracting new interest as an alternative to local area networks. North Star Computers has brought PC compatibility into the multiuser world with the Dimension.

Michael K. Guttman

The introduction of the IBM PC has spawned many imitators but few innovators. One company determined to break that pattern is North Star Computers, of San Leandro, California. North Star, better known for its CP/M-based systems, the Horizon and the Advantage, was one of the first companies to manufacture microcomputers back in 1976. Now the company is breaking ground again with the Dimension, the first multiuser computer to run an IBM PC-compatible operating system.

The Dimension strikes a unique balance between the speed of multiprocessing computers and the flexibility and work station independence of a local area network. Each of up to 12 users gets a monitor and a keyboard connected by cable to an independent work station board in a central system cabinet. The work stations can be located as far as 325 feet from the system unit. Each work station board has an 8088-2 microprocessor, 128K of RAM (expandable to 512K), and a serial port; the boards are joined via an IBM PC-compatible bus and are controlled by an 80186 microprocessor (see Figure 1).

A central processing board contains the 80186, disk controllers, a clock/calendar, one parallel port, two serial ports, and up to 512K RAM. The 80186 microprocessor (the "server") coordinates activity among a half-height 360K floppy disk drive, a 15- or 30MB hard disk, the various expansion boards, and the peripheral ports. The unit includes room for an op-

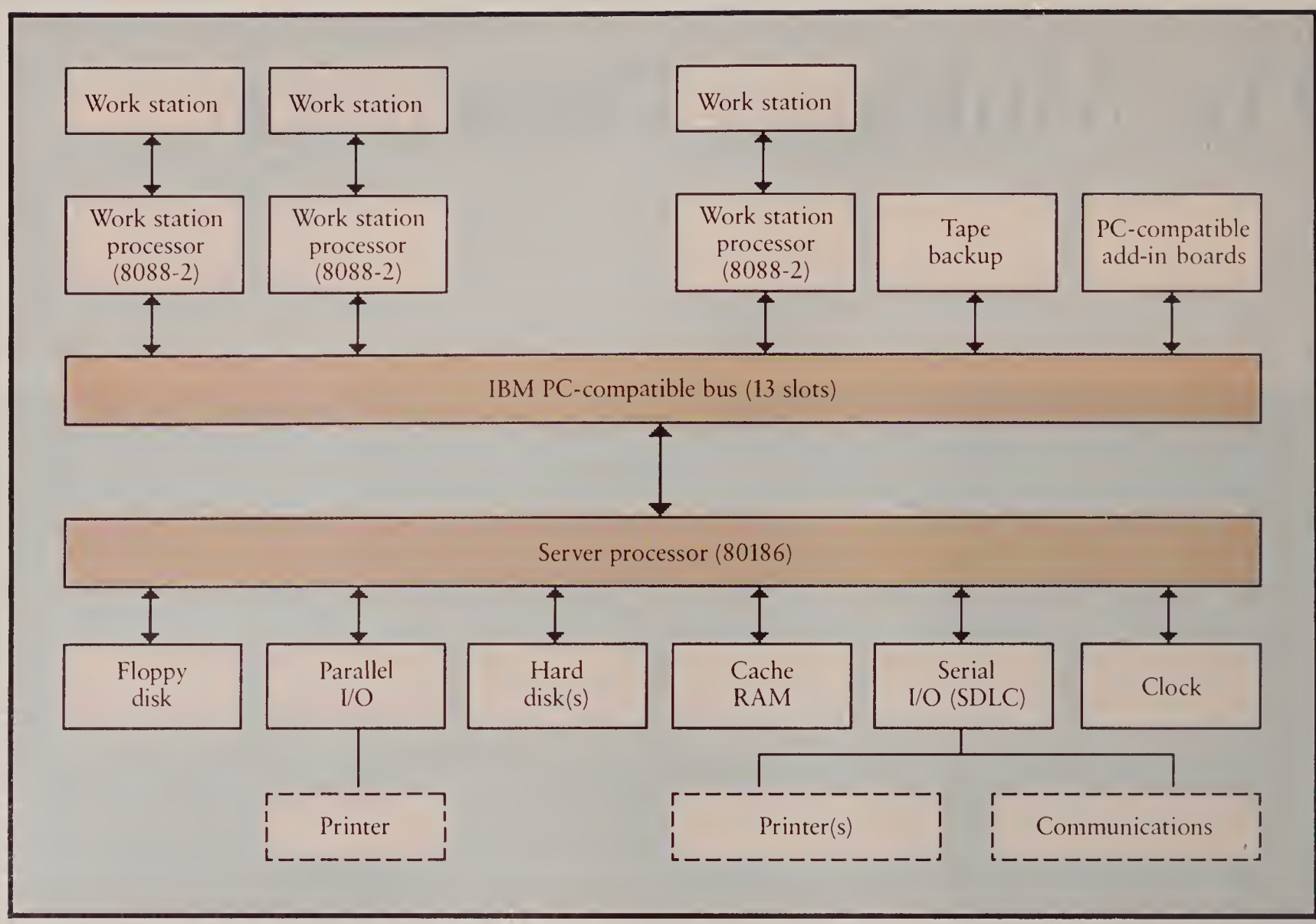

Figure 1: A conceptual diagram of the Dimension's multiuser, multiprocessor system architecture. The bus holds up to 12 work station boards, each containing its own memory and input/output. The 80186 server processor controls shared software and hardware resources and arbitrates requests from work stations.

Courtesy of North Star Computers, Inc.

tional second hard disk and a streaming tape backup that North Star plans to release in the near future (see Figure 2).

The central system unit is housed in a heavy frame that measures 20 by 12 by 24 inches and weighs 60 pounds. Although it occupies more desk space than a PC, the unit is fairly unobtrusive when set upright on the floor. The large power supply at the base requires 450 watts. Two noisy fans are built in to counteract the heat buildup of a fully loaded system. If you have only a few work stations, you can safely disconnect one of the fans to reduce the noise.

The Dimension offers a number of significant advantages over most local area networks (LANs) that use PCs as intelligent work stations. The first advantage is cost. The Dimension is probably the cheapest way currently available to give several users concurrent access to a common hard disk and the ability to share common data files.

A second advantage is speed. Because the 80186 controls the PC bus directly, the Dimension transfers data from its hard disk to individual users at many times the rate of most LANs.

Simplicity is a third advantage. New work stations can easily be added by inserting additional work station boards into the central unit and cabling in the new monitor and keyboard. Each new work station costs $1500. The advantages of cost, speed, and simplicity are countered somewhat by the Dimension's inability to incorporate existing PCs into the system. Currently, only North Star

work stations can be used, but the company is working on a board that will permit you to connect a PC.

Some observers have predicted doom for multiuser computer manufacturers such as North Star because of IBM's recent introduction of the PC AT. While the AT is an impressive multitasking computer—an 80286 microprocessor enables it to run several programs or tasks simultaneously—its effectiveness as a multiuser system is limited. The initial version of the AT can support only two PCs acting as work stations, although third-party vendors have already offered enhancements that enable the AT to support up to eight users.

As a multiuser system, the AT acts more or less like a time-sharing system, with connected terminals vying for the attention of the AT's single processor. In the Dimension environment, every terminal has its own processor, with management and hard disk access controlled by a fast 80186 microprocessor. The AT will no doubt cut into multiuser sales, but offices that require more than three work stations may want to look to multiuser systems like the Dimension.

On and Off the Bus

According to North Star, each work station on the system should perform like a high-speed PC XT. To verify this claim and to evaluate the Dimension's capabilities in general, tests were performed on a two-user evaluation system that included a central unit with a 15MB hard disk and two 256K work stations. The system was in almost continuous operation for several months, running a large collection of PC-compatible software.

Each Dimension work station is essentially an IBM PC clone. Most data processing takes place locally and involves only the work station board and peripherals attached to the work station. Whenever processing requires that the hard disk or other shared peripherals be accessed, the work station board relinquishes control to the server.

When two or more users simultaneously request access to the hard disk, the use of a peripheral, or another service, the server decides which station goes first. Once a request has been honored, control returns to the chosen work station board, which then resumes normal processing. The second work station waits until the first finishes its chore; no second request is necessary.

This form of multiuser architecture, called multiprocessing, is modeled after the star networking topology used with mainframe systems and LANs. The Dimension's work station boards are like the outside nodes of the star, and the server is like the hub. However, under the Dimension's architecture, all communication between the work stations and the server takes place directly on the PC bus, greatly increasing the speed and reliability of data transfer and processing.

To succeed in designing a PC-compatible multiuser computer, North Star had to leap several formidable hurdles. The most glaring problem was MS-DOS's inability to handle multiple processors contending for resources on the same system. The PC bus also posed problems, because it could not reserve a communication and control line for the server—a must for multiuser function. North Star managed to solve these problems without sacrificing PC compatibility.

The Dimension is probably the cheapest way currently available to give several users concurrent access to a common hard disk.

The Work Stations

Once a work station board is mounted onto the bus, its external connector sticks out at the back of the central unit like an add-on board in a PC. North Star provides a 25-foot cable that plugs into the connector on one end and terminates in a junction box on the other. Extra cabling is available to extend a work station to a maximum of 325 feet from the server. The junction box has a modular telephone jack for the keyboard, a composite video connector for the monitor, and a serial connector for a printer or another peripheral.

Each Dimension work station comes with a monochrome interlaced graphics monitor that is generally inferior to the IBM Monochrome Display, although it's superior to the IBM color

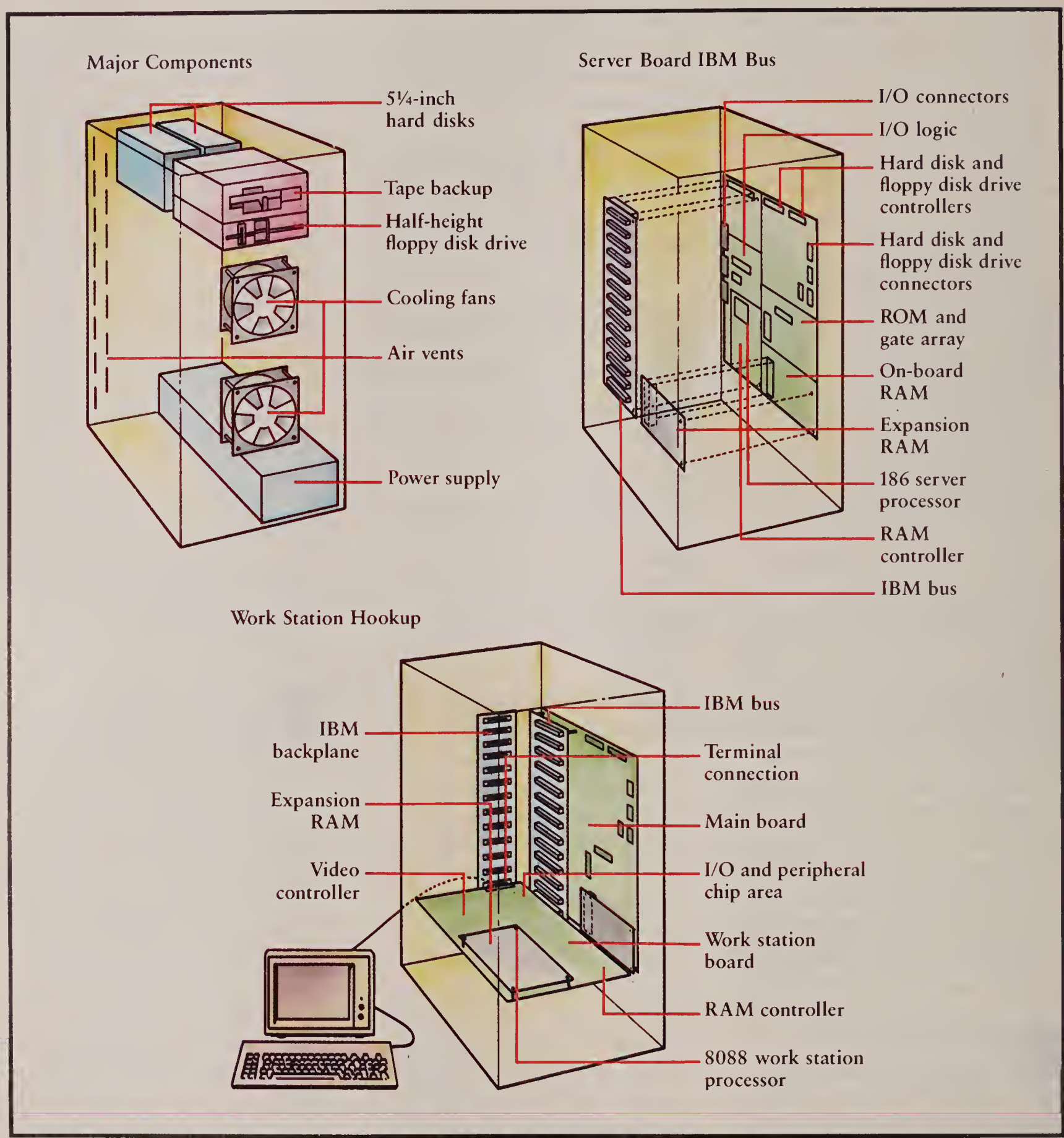

Figure 2: Internal configuration of the Dimension's central unit, which acts as a server for up to 12 work stations. The tape backup shown here was not yet available at the time of this review.

Courtesy of North Star Computers, Inc.

monitor. Images are fuzzy and the monitor has a barely perceptible flicker. An optional tilting pedestal is available. Unfortunately, you cannot add an off-the-shelf color board to the bus for an individual work station. North Star plans to release a proprietary color work station sometime in the future.

The Dimension keyboard is a mix of good and bad. It features a wider <Enter> key than is found on the IBM PC, status lights on both <CapsLock> and <NumLock> keys, and an extra <Enter> key to the right of the numeric keypad. Unfortunately, the keyboard has a spongy action, which may present problems for fast typists.

A Unique Operating System

At the heart of the Dimension's performance lies its proprietary operating system. Except for a set of auxiliary commands designed to construct and maintain the multiuser configurations, the Dimension's operating system appears functionally identical to MS-DOS 2.11. DOS commands work as expected, as do most software programs. Programs directly dependent on the IBM PC's ROM BASIC won't work, but versions developed for GW BASIC appear to work fine.

Unlike MS-DOS 2.11, Dimension's operating system enables you to accommodate multiple users by dividing the hard disk into as many as 63 partitions of varying size. One partition is reserved for system-wide sharing on a read-only basis, appearing to each user as drive C:. This protected volume normally holds common programs and read-only data. The other partitions are assigned to work stations as personal disk drives. A single work station can be assigned more than one partition.

The Dimension provides several built-in security measures. Only the system manager can configure the system, create new partitions, add new users, or write to the C: drive. Furthermore, all system manager functions require that the manager be alone on the system when maintenance activities are performed.

Several users can be assigned to the same disk partition. A shared partition can be considered either protected (read-only), like the C: drive, or unprotected, like a personal volume. On an unprotected volume, the operating system honors record-locking and file-locking procedures under the 3Com networking scheme (see "Six Leading LANs" in this issue).

The level of data security provided by the Dimension permits the development of MS-DOS multiuser applications such as real-time inventory and scheduling systems.

A Floppy Flaw, a Hard Disk Wonder

Although most buyers will undoubtedly purchase the Dimension with dealer support, North Star's documentation should enable any user with a modicum of computer experience and a good deal of time to set up the system on his or her own. The Dimension comes with a technical reference manual, a manager's guide, and a user's guide for each work station.

Once the Dimension has been configured using a system disk, the operating system boots directly from the hard disk. Once booted, a sign-on "shell" takes over from the operating system, prompting the user for a name and a password, as assigned by the system manager. The sign-on shell also supports an electronic mail system that displays a message if anything is waiting in a user's electronic mailbox. After that, the user enters DOS on drive C:. If desired, the manager can create an extension of the sign-on shell using an AUTOEXEC.BAT file on drive C:.

Once a user enters a particular partition, the Dimension operates like any other PC compatible, with one notable exception. If you intend to transfer data to or from the floppy disk, you must invoke the command REQUEST D from the operating system prompt to gain possession of the floppy drive. The disk drive can then be used as drive A:. Possession of the drive is exclusive, and the current possessor must type RELEASE D to allow another user to take possession. A user cannot use or relinquish the floppy during the execution of an application. This must be done from the operating system level.

This procedure presents a considerable inconvenience. To run a copy-protected program such as Ashton-Tate's *Framework*, you must gain possession of the floppy drive and insert the master disk. Once in the program, you can't exit to the operating system to release the disk for a new user.

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The Dimension's greatest single flaw is the sluggish performance of the server's floppy disk drive. Loading new programs, formatting disks, or backing up data takes significantly longer than on a PC. The future addition of the streaming-tape backup unit should greatly reduce this problem by providing an alternative backup system to the floppy disk.

On the other hand, the performance of the hard disk is quite good. This is partly due to the use of "cache" memory, in which frequently accessed data, such as overlay files or reference files, are held in available RAM on the server's motherboard. If your server has 256K, you can have roughly 100K in cache; if you have 512K, you can have about 360K in cache. Cache memory minimizes disk access, so the entire system works faster. If several users are running the same program held in cache, these time savings are multiplied. On the other hand, if more than four or five users are performing completely different disk-intensive tasks, system performance may suffer. Working under the typical use patterns of a dozen users on a fully loaded system, the Dimension could probably live up to its claim of providing the performance of an IBM PC XT for each user most of the time.

The Dimension user will have to depend almost entirely on North Star itself to supply expansion boards.

PC Compatibility

Considering the problems inherent in creating a multiuser MS-DOS-based operating system, the level of software compatibility offered by the Dimension is impressive. Tests of a large number of programming languages, data base managers, word processors, spreadsheets, financial applications, and custom software on the North Star turned up no PC compatibility problems.

However, hardware compatibility is somewhat limited. Although the Dimension uses an IBM PC-style bus, peripherals added to the bus must have driver software to interface with the server and the multiuser shell. North Star has provided drivers for almost all major external peripherals such as modems, printers, and plotters. However, no board-mounted products from third-party vendors can be used. North Star provides its own memory expansion boards, but color boards, internal modems, mouse controllers, and other expansion boards will be absent from the Dimension for the foreseeable future. North Star is still working on a generalized interface for such shared add-on boards. Since the company does not yet have the market presence necessary to attract third-party vendors, the Dimension user will have to depend almost entirely on North Star itself to supply expansion boards.

Despite some problems and limitations, the Dimension is a solid product and represents significant technological achievement. The advantages of cost, speed, and PC compatibility more than compensate for the slowness and inflexibility of the Dimension's floppy disk drive and the limitations in hardware compatibility. If you have no need for exotic expansion boards in the near future, the Dimension provides a reasonable solution to the problem of sharing computer resources in the office.

Michael Guttman is a general partner of Professional Computer Technologies, a general consulting and software development firm in Chico, California.

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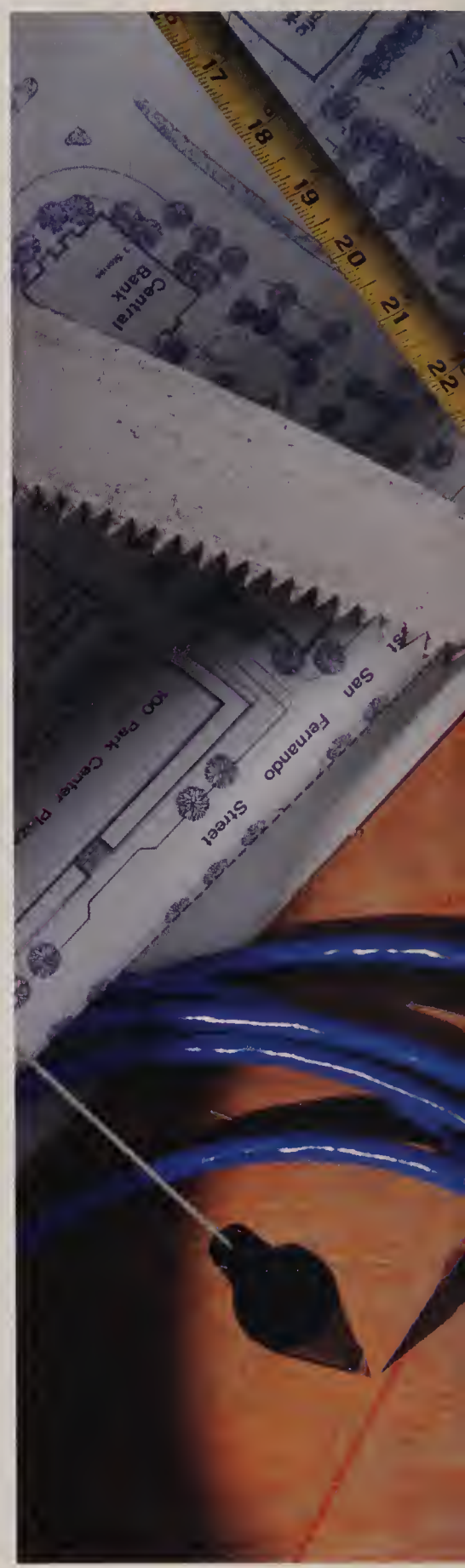
Breaking Ground in Construction



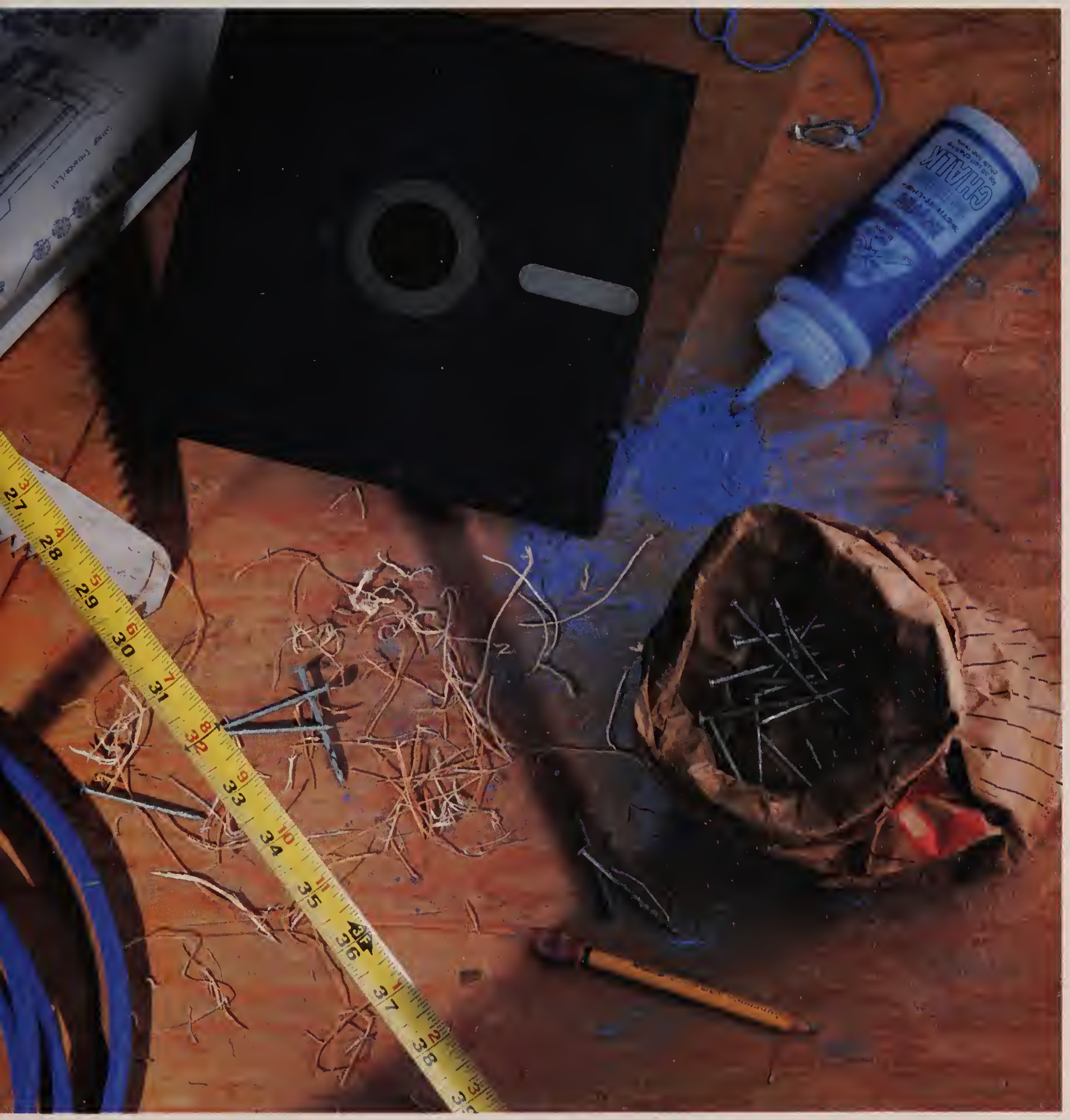
In the roller-coaster world of construction, keeping an eye on expenses and income means getting the job done—and making a profit. Software Shop, one of the first integrated construction accounting packages, can help you do both.

Bill Dauphinais and Alan Ross

One day you're a king and the next you're selling your Cadillac. Such is the life of the real-estate developer and, to a lesser extent, the contractor. Every business is affected by economic swings, but builders are particularly vulnerable because they operate at the mercy of the prime rate. When interest rates skyrocket, construction grinds to a halt. Builders also work against an unrelenting time clock. A contractor putting up a tract home may have only a few months to do everything from grading the lot to painting the finished structure, all the while delicately balancing costs against the income that trickles in from a developer or a bank loan.

Unfortunately, developers and contractors who use PCs haven't gotten much support from software companies in their struggle to keep income in line with outgo—until now. Help has arrived in the form of *Software Shop Construction System*, an integrated accounting package for the PC XT, the AT, or the PC hooked to a Tallgrass hard disk.

Software Shop can satisfy the accounting and data processing needs of small and medium-size real-estate developers, general contractors, and subcontractors. The system is geared to the construction market and offers job costing, general ledger, accounts payable, and payroll modules. *Software Shop*'s billing function just logs invoices; a complete accounts receivable module is sold separately. As Table 1 illustrates, *Software Shop*


CHALK

is a match for many minicomputer-based construction accounting systems, though at $7500 it costs considerably less. The table notes the features you should expect to find in basic and advanced construction accounting programs and how *Software Shop* stacks up.

Construction-Friendly

Creating a sophisticated accounting system that is also easy to use is a challenge that *Software Shop* meets admirably. Even the packaging is designed to disarm the wary computer user. The entire four-module system comes in a bright blue container that is somewhat bigger than a bread box. Inside you find, along with documentation and disks, a tape recorder (with batteries included, no less) and a cassette tape that guides you through the installation manual, Getting Started.

In use, *Software Shop* more than proves its user-friendly mettle. This menu-driven system combines a comprehensive set of general accounting functions, including features unique to the construction industry, with thorough help screens. Another aid is the system's extensive and consistent use of the PC function keys. For example, the <F1> key always displays in-context help messages, <F3> displays the previous prompt, and <F5> and <F6> respectively move the cursor up and down menu selection screens.

Because you can review entered data before you "post" it to the general ledger module, errors are reduced. This batch approach to data entry also conserves computer resources; large amounts of data can be entered during the day and later processed and posted when computer use is light. If your XT is hooked up to a color monitor, the system further enhances the data entry process by highlighting key fields and necessary user responses in color.

> Software Shop's *batch approach to data entry conserves computer resources; large amounts of data can be entered during the day and later processed and posted when computer use is light.*

What makes *Software Shop* particularly attractive is its full integration of different accounting functions. Data from one module (such as payroll) can easily be shared with others in the system—duplicate data entry is eliminated. A set of data, such as employee hours, entered in the payroll module (for issuing paychecks) can be used by the job cost module for cost analysis. Relevant data is captured and passed among modules automatically.

Managing Job Costs

The basic construction unit is the "job." A job might be "the DeLuca house" or "5 Main Street." A builder responsible for a housing development may have to track hundreds of jobs having different pay rates and contract limits. Keeping a finger on the pulse of all this activity—monitoring and controlling the labor and material costs associated with these jobs—is vital if a builder wants to stay in business, let alone make a profit. But developers, general contractors, and subcontractors have differing requirements. For example, developers are concerned with subcontractors' prices but not with the cost of materials, while subcontractors are concerned about materials because they provide them.

Software Shop is flexible enough to accommodate the job cost requirements of all three builders. For the real-estate developer, the job cost module can manage subcontractors, accommodate contract changes made by a developer and a subcontractor, and account for draws made by the developer against a construction loan. For the general contractor, *Software Shop* can handle labor and material costs and bill them to the appropriate jobs. Even the subcontractor is covered; the system deals not only with estimated costs, labor hours, and job billing but with quantities "put in place," such as tons of concrete poured.

Software Shop posts actual labor hours and related payroll costs

(continues on page 157)

Table 1: Standard construction accounting features checklist

	Job cost features	Basic	Advanced	Software Shop
Job cost data	Number of job code digits	3	6	6
	Extra description lines		●	●
	Job category		●	●
	Estimated-dollars-by-cost code		●	●
	Estimated-hours-for-labor-cost codes		●	●
	Estimated-quantity-for-material-cost codes		●	●
	Actual-dollars-by-cost code	●	●	●
	Actual-hours-for-labor-cost codes		●	●
	Actual-quantity-for-material-cost codes		●	●
	Estimated income by phase		●	●
	Actual income billing by phase		●	●
	Contract date		●	●
	Retainage percent by phase		●	●
	Retainage billing by phase		●	●
Processing features	Transaction/batch data entry		●	●
	Tracks estimated/actual income from billing and posts general ledger (GL) entries		●	●
	Processes change orders to original contract and sub-contractor cost estimates		●	●
	Subcontractor control by cost code including retainage tracking		●	●
	On-line inquiry to:			
	Actual cost vs. estimated cost by job and phase		●	●
	Actual income vs. estimated income billing by job and phase		●	●
	Transaction history posted by cost code		●	●
	Processes quantities put in place by cost code		●	●

continues

Table 1 *(continued)*

	Job cost features	Basic	Advanced	Software Shop
Reports	Job file listing	●	●	●
	Job estimate listing		●	●
	Actual vs. estimated quantity analysis		●	●
	Cash flow by job		●	●
	Job cost transaction history	●	●	●
	GL transaction summary		●	●
	Job cost billing status report		●	●
	Job cost variance analysis		●	●
	Job field worksheet		●	●
	Subcontractor status report		●	●

	General ledger features	Basic	Advanced	Software Shop
General ledger data	Account structure:			
	Code number length	4	10	7
	Assigns department code		●	●
	Assigns company code		●	●
	Alphanumeric codes		●	
	Data elements:			
	12 accounting periods	●	●	●
	13 accounting periods		●	●
	Year-to-date	●	●	●
	Monthly budget data		●	●
	Prior year–actual monthly data		●	●
	Nonfinancial data		●	

	General ledger features	Basic	Advanced	Software Shop
Processing features	Transaction/batch data entry	●	●	●
	Multiple-company processing		●	●
	User-defined fiscal months		●	●
	User entry/maintenance of reversing journal entries; automatic updates		●	●
	User entry/maintenance of recurring journal entries; automatic updates		●	
	Automated closing		●	●
	Automated account consolidation		●	●
	Automatic offset entries		●	●
	Automatic distributions/allocations		●	●
	Processes current month transactions prior to closing earlier month(s)		●	●
Reports	Chart of accounts	●	●	●
	Transaction journals	●	●	●
	GL activity and trial balance	●	●	●
	Basic reports:			
	Income statement		●	●
	Balance sheet		●	●
	Budget		●	●
	Actual vs. budget		●	●
	Actual vs. last year		●	●
	Departmental expense reports		●	●
	Columnar comparisons		●	●

continues

Table 1 *(continued)*

	Accounts payable features	Basic	Advanced	Software Shop
Vendor and invoice data	Vendor data: name, address, phone, purchases this year, purchases last year, normal discount terms, last payment date	●	●	●
	Discounts taken this year, last year		●	●
	Discounts lost this year, last year		●	●
	Invoice data: amount, account distribution	●	●	●
	Dates:			
	Invoice date	●	●	●
	Due date	●	●	●
	Discount due date		●	●
	Discount terms		●	●
	Purchase order number		●	
	Material units		●	●
	Subcontractor retainage		●	●
Processing features	Transaction/batch data	●	●	●
	Will hold invoice payment	●	●	●
	User entry of manually prepared payments	●	●	●
	User specification of payment date and starting check number for check printing	●	●	●
	Payment by:			
	Received invoice, vendor	●	●	●
	Job, due date		●	●
	Preview checks or payments		●	●
	Custom check format		●	
	User adjustments of current payables		●	●
	Single vendor file used for multiple companies		●	
	Captures and processes job cost data		●	●
	User-defined aging periods		●	
	On-line inquiry to open payables by job, vendor, invoice, due date		●	●
	Partial payment option		●	●
	Check reconciliation		●	●

	Accounts payable features	Basic	Advanced	Software Shop
Reports	Vendor master listing	●	●	●
	Invoice and account adjustments registers	●	●	●
	Open-item listing	●	●	●
	Selected payments listing		●	●
	Checks and stubs	●	●	●
	Check register	●	●	●
	Aged trial balance		●	●
	Cash requirements summary by week		●	
	Purchases journal		●	●
	1099 forms		●	●
	GL transaction summary		●	
	Subcontractor payments report		●	●

	Payroll features	Basic	Advanced	Software Shop
Payroll data	Basic data: employee name, address, social security number, hire and termination dates, salary/wage rate	●	●	●
	Accrued vacation/sick hours		●	●
	Department number		●	●
	Personnel/benefits data:			
	Pension plan eligibility		●	●
	Union Information		●	●
	Sex		●	●
	Minority classification		●	●
	Job code and skill level		●	●

continues

Table 1 *(continued)*

	Payroll features	Basic	Advanced	Software Shop
Processing features	Transaction/batch data entry	●	●	●
	User override of payroll amounts for special adjustments	●	●	●
	Entry of cash or manual check payments	●	●	●
	Hourly or salaried employees	●	●	●
	Multiple pay frequencies		●	●
	Captures job cost/labor distribution data		●	●
	Multiple state or local taxes		●	●
	Custom check formatting		●	
	Check reconciliation		●	●
Reports	Employee master-file listing	●	●	●
	Time card/sheet listing	●	●	●
	Payroll register	●	●	●
	Checks and stubs	●	●	●
	Check register	●	●	●
	Payroll deductions by type	●	●	●
	W-2 forms		●	●
	941 forms		●	●
	GL transactions summary		●	●
	Labor distribution by department, job		●	●
	Minority utilization report		●	●
	Worker's compensation report		●	●

(continued from page 150)

to each job directly from the payroll system. Similarly, actual material use, material costs, and subcontracted expenses are posted to a job from the accounts payable system. Reports generated by the job cost package highlight differences between estimated and actual figures for labor hours, units of material, and costs.

Naturally, the success of any small developer or general contractor also hinges on the ability to monitor subcontractor expenses effectively. Toward this end, the *Software Shop* job cost module links a subcontractor's original contract fee and "retainage" amount to the cost code assigned to that subcontractor. (Subcontractors don't get their money all at once; they draw against their contracts as jobs progress. This kind of billing is imprecise, so a percentage of the subcontractor's fee—perhaps 10 or 15 percent—is held back until the job is completed satisfactorily.) A contractor can then track contract changes, invoices, periodic payments, and retainage payments for each subcontractor. Status reports that list original contract amounts, retainages, amounts billed to date, payments made, and outstanding balances are available (see Figure 1).

The job cost module makes overpaying a subcontractor unlikely, because the program automatically checks a subcontractor's

We're Cullinet, the acknowledged leader in mainframe software. Our customers include some 2,000 of the world's biggest and best-run companies.

So when we set out to develop a superior integrated *personal computer* software package, we didn't have to guess what business wanted. We simply had to ask.

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The fact is, anyone can begin to use GOLDENGATE in a matter of minutes. A single command set operates every function, so a GOLDENGATE user enjoys a single learning experience, rather than several. Tutorials and complete on-line help screens allow the novice to become productive *without training.*

To top it off, GOLDENGATE—in combination with our IDB mainframe software—provides micro-to-mainframe integration that makes accessing corporate data indistinguishable from accessing data on a diskette.

For more information about GOLDENGATE, phone Cullinet toll-free, 1-800-551-4555.

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SUBCONTRACT STATUS REPORT

JOB NUMBER	VENDOR NUMBER	PHASE	COST CODE	INVOICE NO./ DESCRIPTION	CONTRACT AMOUNT	RETAINAGE AMOUNT	AMOUNT BILLED	AMOUNT PAID	CONTRACT BALANCE	DATE ENTERED
500		Job 500								
	Cham			Cunningham's Heating/Air						
		100-1630	-S	Septic Tank	2,100.00	1,050.00			2,100.00	09 JUL 1983
				TOTAL.....	2,100.00	1,050.00			2,100.00	
	123			GRADECO						
		100-1810	-S	Grading - Excavating	500.00	25.00			500.00	09 JUL 1983
		100-1810	-S	digging foundation			500.00		500.00	15 JAN 1984
		100-1810	-S	digging foundation				500.00		15 JAN 1984
				TOTAL.....	500.00	25.00	500.00	500.00		
	Framers			Anderson & Sons Framers						
		100-1843	-S	Concrete finishing	180.00	9.00			180.00	09 JUL 1983
		100-1843	-S	Finishing			180.00		180.00	01 FEB 1984
		100-1843	-S	Finishing				180.00		01 FEB 1984
				TOTAL.....	180.00	9.00	180.00	180.00		
	MastPlum			Master Plumbers						
		100-1860	-S	Extermination svc	165.00	8.25			165.00	09 JUL 1983
				TOTAL.....	165.00	8.25			165.00	

Figure 1: A subcontractor status report lists the subcontractors working on a particular job, the job phase they worked on, the type of work done, invoices received from subcontractors, money paid and retained, and contracted fees.

bill against the contract amount. This feature is particularly useful if a contractor is working on more than one job—such as the Plaza Hotel, The Four Seasons Restaurant, or 1 Park Avenue—and different payment rates and schedules must be sorted out.

At the other end of the deal, a subcontractor can use *Software Shop*'s job cost function to determine how much to bill for completed or partially completed projects and to roughly determine profit and loss by job. *Software Shop* lets the user divide estimated income into any number of construction phases. (The construction industry defines 15 major phases that run the gamut from laying a foundation to putting on a roof. Phases have subcategories called cost codes, which provide for further cost breakdowns.) The program produces a cash-flow report that compares actual to estimated costs and actual to estimated billings and lists estimated costs and revenue for jobs not completed yet. If tracking construction income is not important, the billing feature can be used to manage the subcontractor's cash position. In that case, the job cost system compares actual costs to draws made against a construction loan.

General Ledger

Software Shop's general ledger module is similar to many stand-alone and integrated general ledger programs currently on the market. The program accounts for different companies, reports budgeted versus actual amounts, automatically reverses journal entries, and generates typical financial reports with its simple report writer.

However, there are a few design flaws that make the general ledger package the weak link in what is otherwise a powerful system. The report writer can summarize only 36 accounts into one report line. This may not present a problem for most builders, but anyone trying to prepare high-level financial statements like those required by a bank would find this limitation inconvenient. Account numbers are limited to 7 digits, which, depending upon the complexity of your financial reporting, could be restrictive. Worse still, the program does not automatically close profit and loss accounts and calculate retained earnings—something most general ledger systems do as a matter of course.

Accounts Payable

Software Shop's accounts payable module is as powerful as most advanced accounts payable packages. The program features a check reconciliation capability and an option for making partial payments on invoices. As you might expect, the system is slanted toward the construction industry. You can look at current amounts owed ("open payables") by job, pay invoices associated with a specific job, and track retainage. The package is fully integrated with both the general ledger and job cost functions.

Since the accounts payable function can work on a cash or an accrual basis, it can fit companies that use either accounting method. In the accrual mode, *Software Shop* functions like a typical accounts payable system. However, in the cash mode invoices are not reflected in job cost reports until they are paid. Since invoices are entered into an accounts payable file, they can be viewed with *Software Shop*'s inquiry command (see Figure 2). Unfortunately, a payable file is restricted to one company—a possibly significant limitation in an industry in which many developers divide operations into several distinct business entities.

Payroll

Software Shop takes a relatively simple approach to payroll and tailors it to the needs of the construction industry. For example, you can establish a pay-rate table that varies with an employee's job position and skill level, such as carpenter or apprentice. Aside from handling unique

Managers know that a critical decision is only as timely as the information that goes into making it. The promise of personal computers has always been to deliver information to corporate managers in time to act upon it.

Only one software company can make a claim for integrating the two things that deliver that promise: the mainframe, from which all information flows, and the microcomputer, where someone has to make sense of that information.

GOLDENGATE™ from Cullinet is not only an exceptional integrated software package. In combination with our Information Database (IDB), it creates an environment for the corporate pc user which makes accessing information in the company mainframe *indistinguishable* from accessing information on a diskette.

The benefits are obvious: "what-if's" on live data, reports that are current as of this moment, and most important, the ability to act on today's problems today. And all accomplished independently right at the pc.

Cullinet is the recognized leader in mainframe software, which makes the introduction of GOLDENGATE significant. The singular ability of GOLDENGATE to provide easy-to-use, yet sophisticated, micro-mainframe integration makes it as timely as today's news.

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J O B C O S T V A R I A N C E R E P O R T

JOB NUMBER - 500
Job 500
Blue Ridge Resort - Lot 400
A-Frame, 2 Bdr. - Type C
Cedar siding

For: Arnold Smith
Phone: (515) 366-9275
To-be-completed 05/15/83

PHASE	COST CODE	COST DESCRIPTION	QUANTITY ESTIMATED	QUANTITY ACTUAL	QUANTITY VARIANCE	HOURS ESTIMATED	HOURS ACTUAL	HOURS VARIANCE	DOLLARS ESTIMATED	DOLLARS ACTUAL	DOLLARS VARIANCE
100-1300	-L	Site Work/Gen Labor				40.00		40.00-	1,200.00	1,356.18	156.18
		COST CODE TOTAL				40.00		40.00-	1,200.00	1,356.18	156.18
100-1620	-L	Water Supply				15.00	15.00		200.00	200.00	
100-1620	-M	Water Supply	1	1					500.00	468.32	31.68-
		COST CODE TOTAL	1	1		15.00	15.00		700.00	668.32	31.68-
100-1630	-S	Septic Tank							2,100.00		2,100.00-
		COST CODE TOTAL							2,100.00		2,100.00-
100-1810	-S	Grading - Excavating							500.00	500.00	
		COST CODE TOTAL							500.00	500.00	
100-1840	-L	Misc Site Work				20.00	20.00		140.00	140.00	
		COST CODE TOTAL				20.00	20.00		140.00	140.00	
100-1842	-L	Steel				30.00	35.00	5.00	300.00	300.00	
100-1842	-M	Steel	200		200-				575.00	450.00	125.00-
		COST CODE TOTAL	200		200-	30.00	35.00	5.00	875.00	750.00	125.00-

Figure 3: The job cost variance report compares reality with projections, in this case comparing estimated and actual materials put in place, labor hours spent, and costs incurred. Variance figures—how much reality and projections differ—are displayed on the right of each major column.

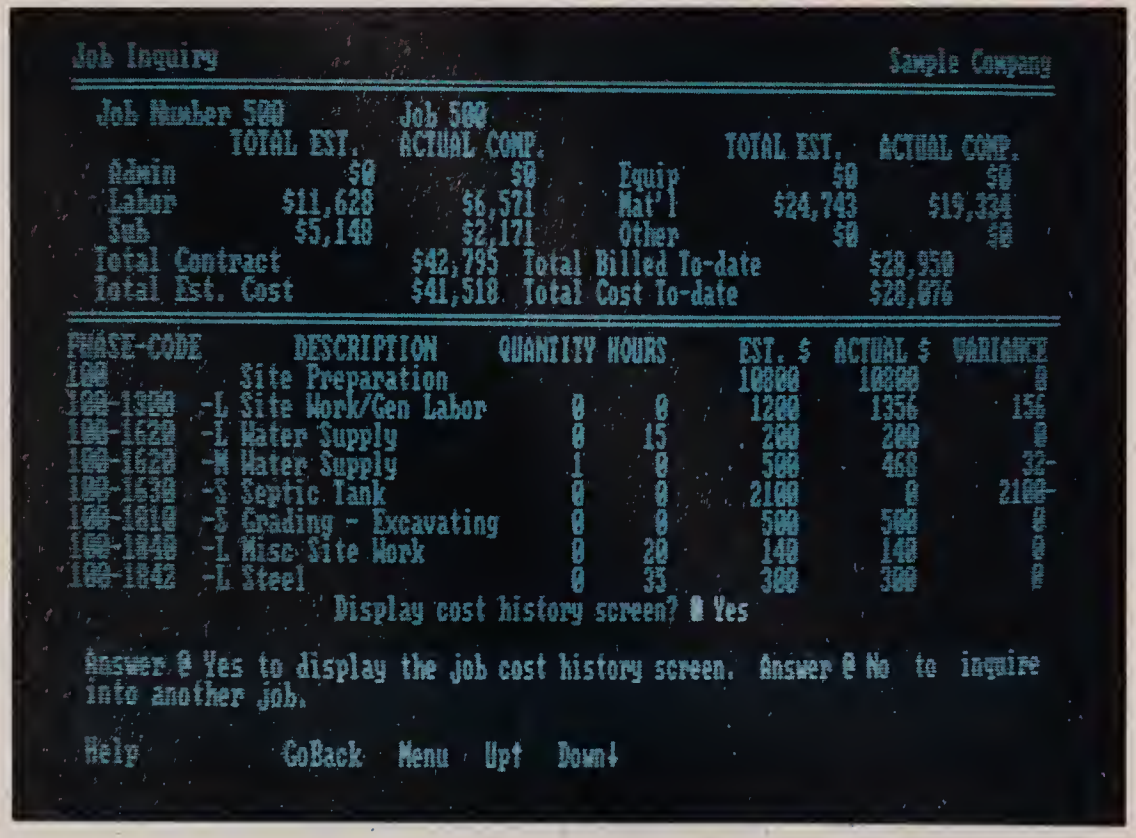

Figure 2: A Software Shop inquiry screen for Job #500. Actual and estimated costs and billings to date are shown in the top window. The bottom window displays the job's cost breakdown by phase.

pay-scale variations, the package supplies ten deduction categories, including those associated with union withholdings. Like the accounts payable package, the payroll system handles payroll bank-account reconciliation.

One feature the package lacks is the ability to calculate accrued vacation and sick hours for each employee. This information is particularly important in the construction business, because union agreements are often specific about these benefits.

Reports

Although *Software Shop*'s primary goal is to maintain accounting records, the system can produce more than the standard accounting reports. For example, the job-cost status report shows a job's estimated cost, cost to date, contract amount, and billings to date. The system even reports cost

over billings, a handy way for spotting potential cash-flow problems. A cost-over-billings report might indicate that you have to do more billings or that you're running in the red. The more detailed job cost variance report (see Figure 3) identifies actual versus budgeted data for every cost category within a given job. The variance report makes it possible to monitor such critical variables as amount of materials used, labor hours expended, and related costs.

Software Shop's report writer can also create relatively detailed income statements and balance sheets, but it can't produce custom management reports. However, you can create such reports with *Shoplink*, a new *Software Shop* module that permits you to "export" data to programs such as *dBASE II, 1-2-3,* and *VisiCalc.*

Documentation

Many software packages come up short in the user manual department, but the designers of *Software Shop* have done their homework. Each package comes with an indexed, clearly written, and comprehensive manual that includes menu selections, sample reports, error messages, a glossary, sample forms, and tips for setting up your books. In keeping with its user-friendly approach, the manual incorporates a step-by-step tutorial that guides you through each menu selection with sample data and program responses. A checklist of things to do on a daily, month-end, and year-end basis is included to remind you of important accounting tasks.

You have to do everything well.

Those who succeed in business are those who consistently demonstrate a high level of skill in a variety of areas. In forecasting, in planning, in implementing, in managing.

GOLDENGATE™ is a business tool that can help you perform your best in each.

A product of Cullinet, the recognized leader in mainframe software, GOLDENGATE is a functionally rich integrated pc package. It combines spreadsheet database, word processing, graphics and telecommunications capabilities. And in combination with our IDB mainframe software, it also provides micro-to-mainframe integration that makes accessing corporate data indistinguishable from accessing data on a diskette.

GOLDENGATE's superior functionality results from its unique architecture. Each function in the program is designed to provide an optimum working environment. And each is linked to the others through core software.

The result is integrated pc software that does each of its jobs exceptionally well, so you can do the same in yours.

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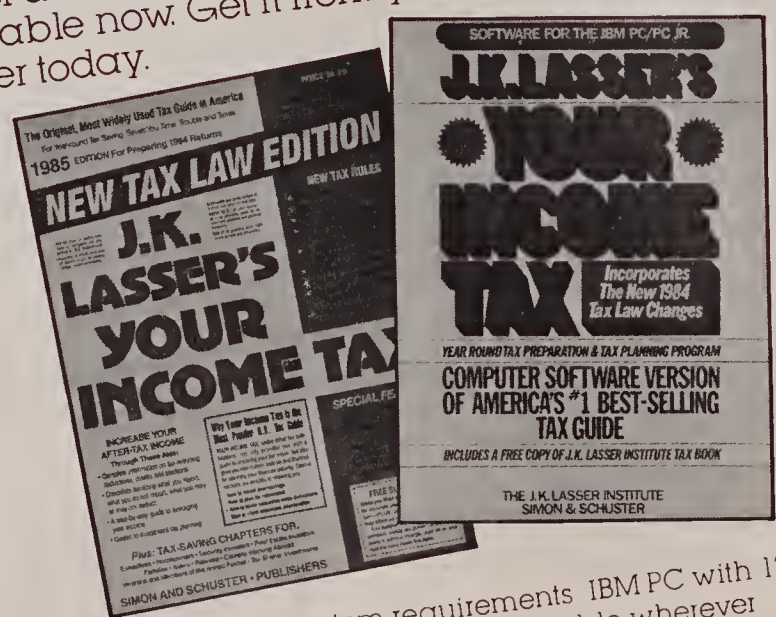

IBM PC Version 0-671-53213-8 $79.95 (system requirements IBM PC with 128K, single disk drive, monitor; printer recommended). Available wherever software is sold, or send payment directly to:

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1230 Avenue of the Americas, New York, NY 10020

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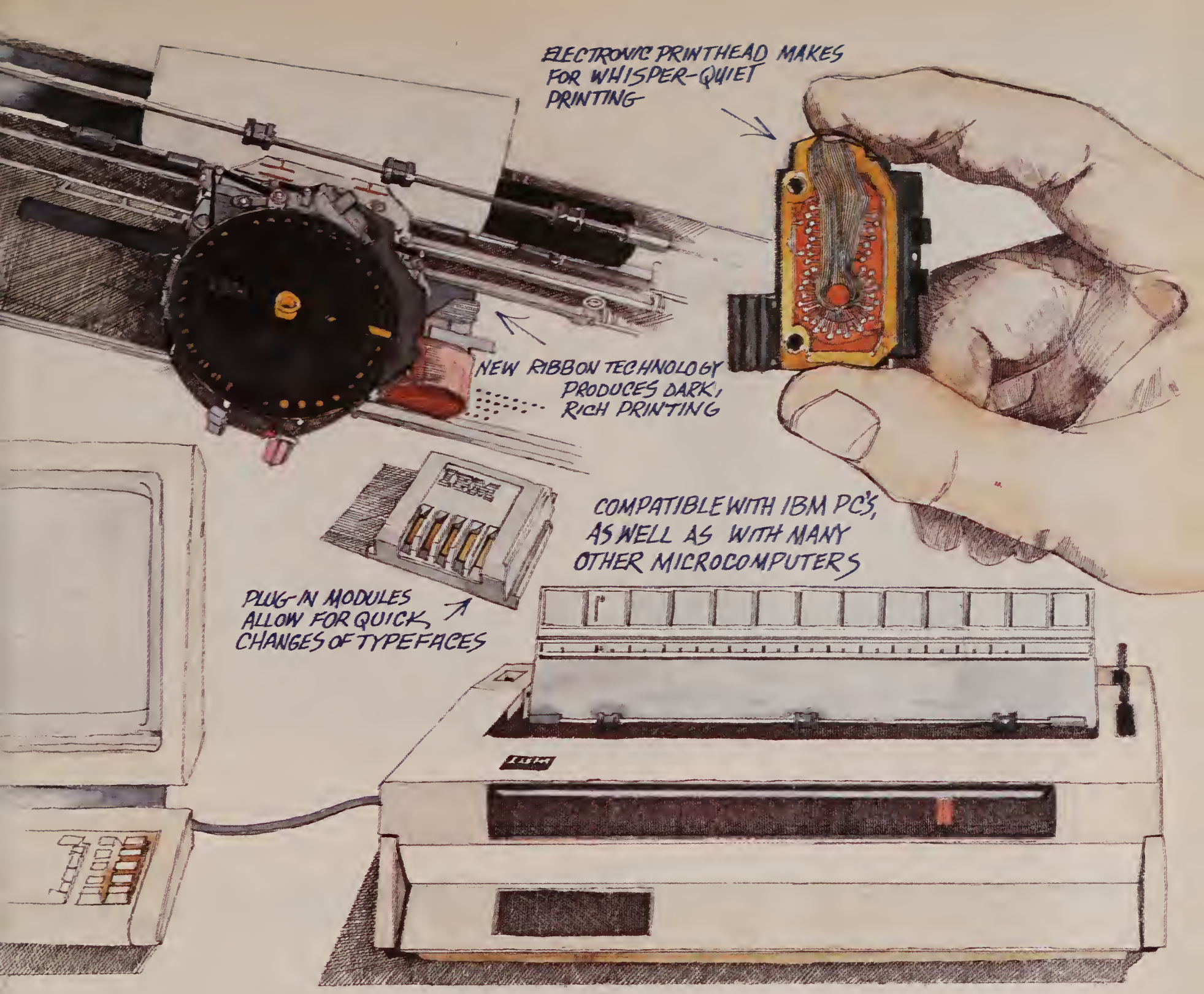
The Bottom Line

Included with *Software Shop* is an encryption board, which fits into one of the XT's short slots and must be installed for the program to work. The board's primary purpose, of course, is to prevent unauthorized copying of *Software Shop.*

In spite of a few failings and the minor inconvenience of installing an encryption board, *Software Shop* represents a thoughtful and comprehensive approach to the data processing needs of small companies involved with development and construction work. If nothing else, the system's integration should make builders' lives easier. *Software Shop* isn't the cheapest accounting package around, but it's one of the few that tackles some demanding construction jobs and does them well.

Bill Dauphinais is a CPA and the partner in charge of management consulting services at the Sacramento, California, office of Price Waterhouse. Alan Ross is a senior manager at the Sacramento office of Price Waterhouse.

Software Shop Construction System
Software Shop Systems
960 Holmdel Rd.
Holmdel, NJ 07733
201/946-8900
List price: without accounts receivable module $7500, with accounts receivable module $8500, Shoplink module $300, accounts receivable module $1500
Requirements: 192K, 10MB hard disk, DOS 2.00 or later version



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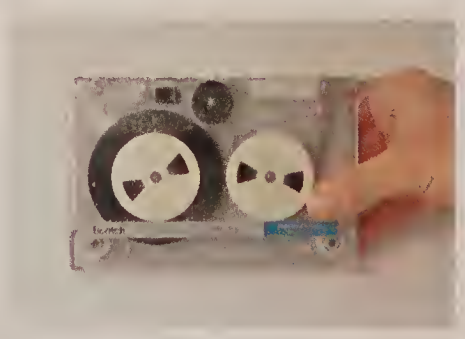

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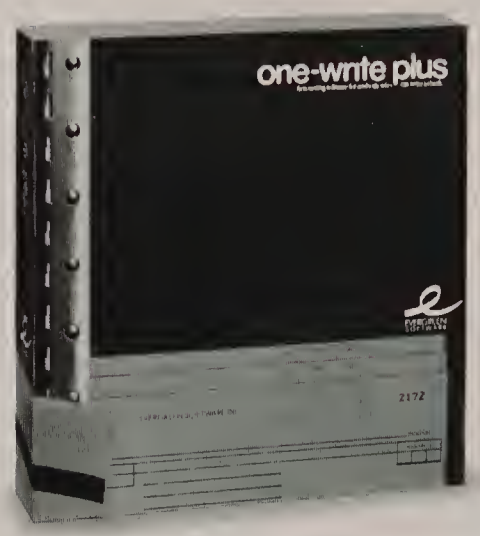

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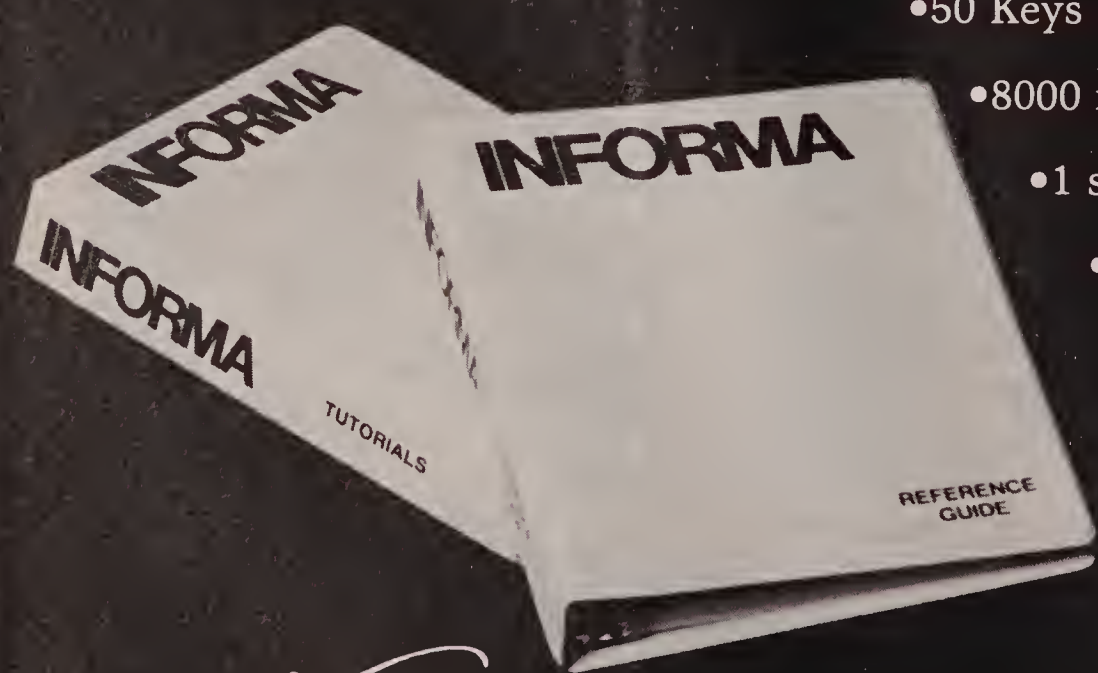

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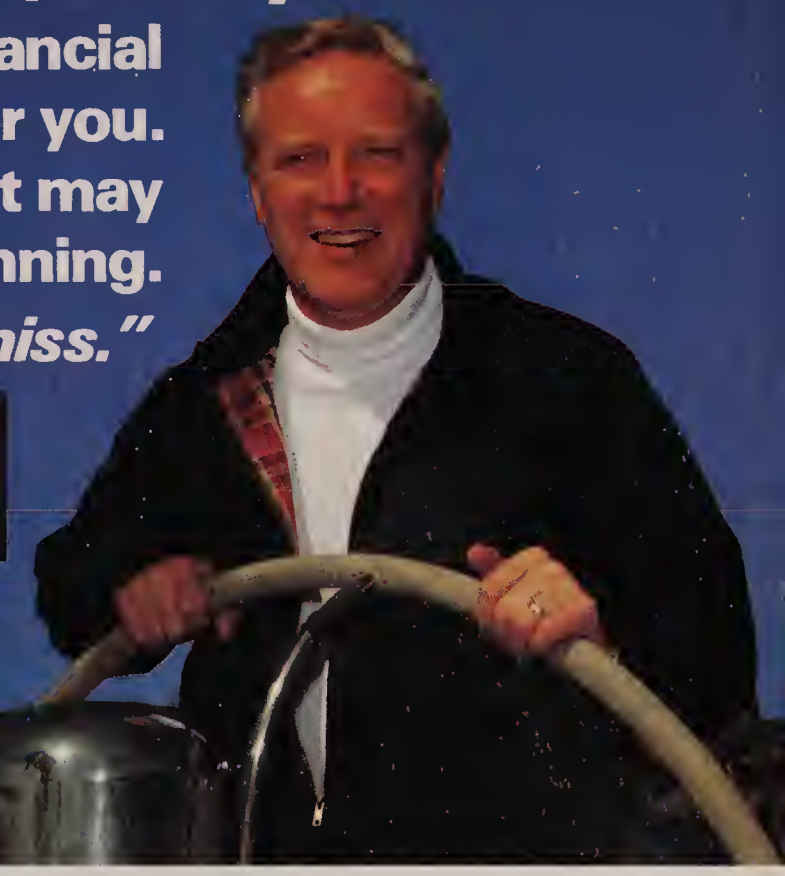

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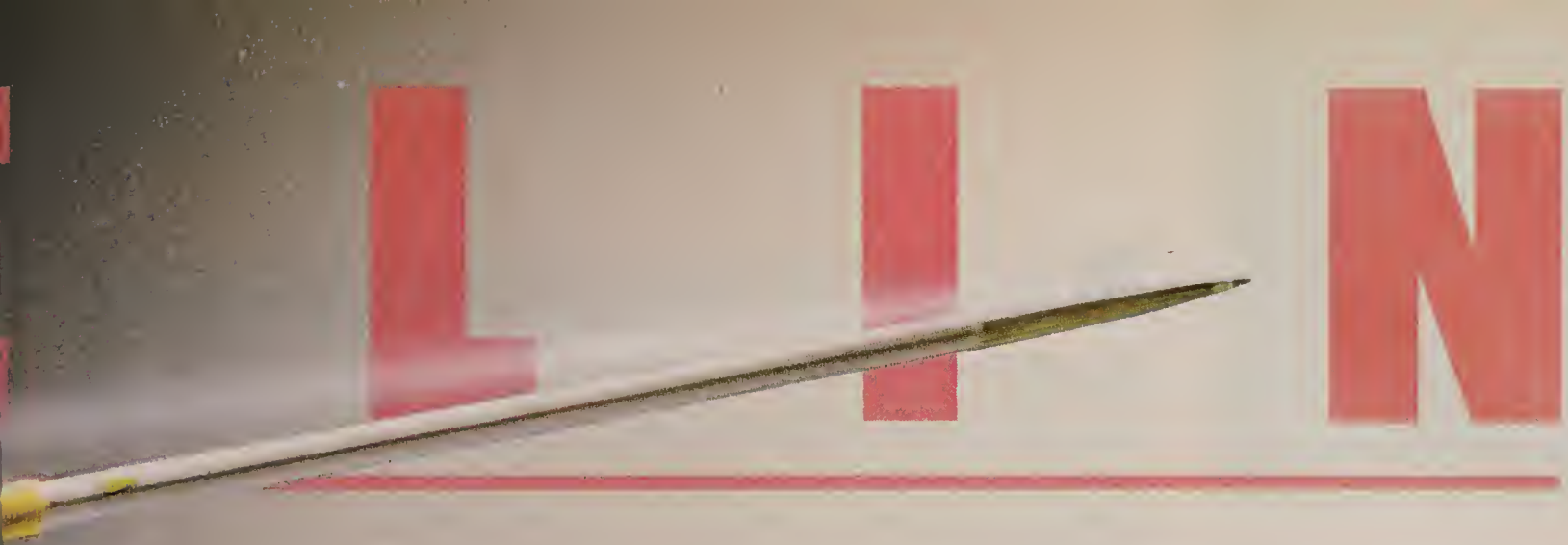

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Circle 243 on reader service card

From the Software Shelf

PC World editors offer first impressions of recent software releases

This month: a 1-2-3 lifesaver, the Tonto of software programs, a soup-to-nuts home package, an electronic equivalent of the Readers' Guide, and yet another too-cheap-to-believe word processor.

Edited by Robert Luhn

Macro-Toolkit

On a typical hectic day at my editorial manager's desk, my attention sometimes wanders. Visions of a totally automated office–editors included–seep into my consciousness. Topo the Robot is running the Xerox machine, answering the phone, and occasionally spraying me with an invigorating dash of Midnite Madness, "the perfume for overachievers." In another corner B.O.B. is sorting my mail and shuffling through my desktop dishabille, deciding which papers to file, forget, or mulch. But as I savor this admittedly whimsical vision, I'm jarred back to reality: I neglected to automate my PC. The question is, can anything duplicate what I do at the computer?

Not quite. But as a full-time *1-2-3* devotee, I can confirm that *Macro-Toolkit for Use With Lotus 1-2-3* comes close. *Macro-Toolkit* won't interface with a Xerox copier or sort mail, but it will automate many *1-2-3,* version 1A, spreadsheet operations–formatting, printouts, complex reports, graphs, and more–at the touch of a key. Even if you're only saving worksheets or adjusting column widths, this utility will perform the operations twice as fast as a human keypuncher and much more scrupulously.

Macro-Toolkit caters to both the *1-2-3* novice who wants to become familiar with macro commands and the experienced user who needs a well-designed set of macros to handle complicated or repetitive command sequences. The *Macro-Toolkit* disk comes with a documentation file and 17 bug-free macros that recalculate specified columns and rows; delete, erase, and print established ranges or address labels from a data base; save a worksheet; convert formulas to values; move data from rows to columns; adjust column width; and much more. For the memory-conscious user, there's a choice of four different macro servings. For example, the Macro 1 file, which contains all 17 macros and some help menus, requires 16K of memory. The Macro 2, 3, and 4 files include many, but not all, of the macros contained in the Macro 1 file and require from 6K to 10K of memory. In many cases 16K is easy to accommodate. But if you are working with a large spreadsheet on a 256K system, using a smaller group of macros may keep you from being stranded down memory lane. For further memory savings, individual macros can be copied to a spreadsheet.

The *Macro-Toolkit* disk also comes with a rather lengthy introduction file that reiterates most of the information in the program's 20-page user manual. Though the introduction is intended to be encouraging, the author's wordy bravado is likely to inspire apprehension–but rest assured, you don't have to be a programmer or a macro whiz kid to use *Macro-Toolkit.* However, you may have problems deciphering the manual's instructions on how to load and install a macro in your *1-2-3* spreadsheet.

The key to unlocking *Macro-Toolkit* is Import, a gofer macro that retrieves and copies macros into a spreadsheet. Once installed with *1-2-3*'s /File Import command, the Import macro will retrieve any macro or group of macros on the *Macro-Toolkit* disk with a single

keystroke. For example, when I finish with a spreadsheet, I always recalculate it, move data from columns to rows to fit a report format, save it, and print the file. With *Macro-Toolkit* it takes only a few keystrokes to execute the Import macro, then load and execute the Calc, Reconfig, Save, and Print macros from the Macro 4 file.

Macro-Toolkit won't answer my phone or brew my morning coffee, but I'll use anything that shaves my work time. And at a little over $2 a macro, you can't beat the value.–*CH*

Macro-Toolkit for Use With Lotus 1-2-3
MicroRealities
P.O. Box 60123
Grand Junction, CO 81501
303/245-8358
List price: $35
Requirements: 128K, one disk drive

SideKick, Version 1.10A

Where would Bogey and Bacall have been without Walter Brennan in *To Have and Have Not?* Bette Davis without Thelma Ritter's wisecracks in *All About Eve?* William Powell and Myrna Loy without Asta's olfactory talents in *The Thin Man?*

Brennan, Ritter, and Asta were members of that rare breed of Hollywood movie star: the character actor, who plays the friend, the workmate–in short, the sidekick. They belonged to that gifted band of actors and occasional lesser mammals who support a movie's big star and often walk away with the best role.

The newest sidekick on the scene isn't from Paramount or Universal but from Borland International, a Scotts Valley, California, software firm known for its popular *Turbo Pascal* package. *SideKick,* version 1.10A, is Borland's noteworthy attempt to create an indispensable pal for all your other programs. *SideKick* includes an electronic calculator, a note pad, an appointment calendar, a slimmed-down auto-dialer and telecommunications program, and an ASCII table. *SideKick* resides in memory and uses windows to superimpose its various functions over PC programs. This updated version of *SideKick* doesn't suffer from the bugs that plagued its predecessor, most nota-

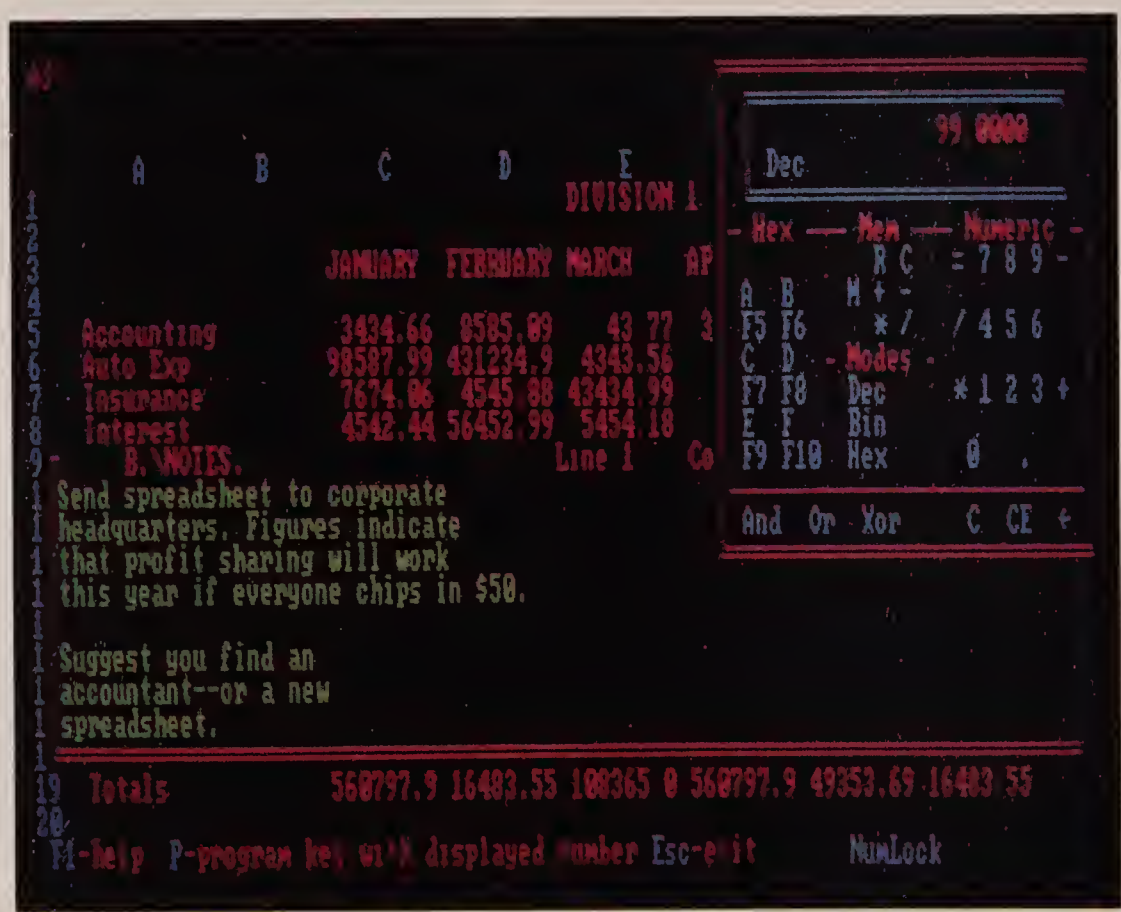
bly the inability to work with Lotus Development's *1-2-3*. With these corrections, Borland just might have another big money-maker on its hands.

SideKick's two most useful utility programs are Notepad and Calculator. With Notepad you can create the electronic equivalent of large Post-it notes that can be edited, saved, and even inserted into other documents. Though Notepad's margins are permanently set for 40 characters, a note can be as long as your system's memory permits. Notepad uses many *WordStar*-like control sequences and includes familiar insert, delete, and block-move features. Calculator does the job of a hand-held calculator. If you need to tally numbers in a business report, verify the accuracy of a *1-2-3* formula, or merely check your math, Calculator can be popped onto the screen with a single key combination. It can manipulate 18-digit numbers, recognize some algebraic structures, and perform AND, OR, and XOR (A or B, but not both) logical operations. Calculator operates in decimal, hexadecimal, and binary modes and will convert numbers from one mode to another—features that will appeal to programmers.

SideKick's calendar function not only displays any month from the year 1900 through 2099 but, more important, sets up a daily appointment schedule divided into half-hour intervals from 8 a.m. to 8 p.m. The Dialer is a simple telecommunications program that works with the Hayes Smartmodem and compatible modems. Numbers can be dialed from either the keyboard or Dialer's directory or pulled in from data base records. In the latter case, you display the record, move the cursor to it, open Dialer's directory, and give the dial command. The number is highlighted and dialed automatically. *SideKick*'s last feature—an ASCII table of the PC's character set—is mostly for programmers. All *SideKick* functions can be displayed simultaneously (see Figure 1).

Lest I sound rhapsodic, be forewarned: *SideKick* is copy protected. I can live with this inconvenience, but most PC XT owners can't, because they have but one floppy disk drive. To bypass this problem, users of XTs and other hard disk PCs must send Borland an extra $29.95 to receive an unprotected copy of the *SideKick* disk—something I suspect that earlier users didn't discover until after they had purchased the program. Until recently, Borland has failed to mention *SideKick*'s copy protection in advertising or on the program's packaging. This sin of omission has wisely been corrected.

Copy-protection issues aside, *SideKick* is a useful, easy-to-learn program that many people will find handy. But I don't think *SideKick* is destined for a movie career. After all, the program couldn't answer the question "Was you ever bit by a dead bee?"—*KS*



No spreadsheet or any other program need be an island with Sidekick. In this instance, Sidekick's notepad and calculator applications are used in conjunction with a 1-2-3 spreadsheet.

SideKick
Borland Int'l
4113 Scotts Valley Dr.
Scotts Valley, CA 95066
408/438-8400
List price: $49.95
Requirements: 64K, one disk drive

A>Cook: The Complete Computer Recipe System

I'm especially skeptical when it comes to home software. I always ask myself, does the program accomplish a task better left to pencil and paper? Are the purchase price and the time needed to learn the program more than compensated for by the time and effort saved using the program? *A>Cook: The Complete Computer Recipe System,* from East Hampton Industries, acquits itself on both counts–with a few qualifications.

At first glance I thought *A>Cook* represented another attempt to sell a product by creating a need where none existed. Why use the PC to keep track of recipes? I was pleasantly surprised to find that *A>Cook* is a very handy, fast recipe-indexing program. If you like to cook and find yourself frequently searching through stacks of cookbooks, loose clippings, and sticky recipe cards, *A>Cook* might be the kitchen organizer you need.

Each reference includes a recipe number (assigned by *A>Cook* when the recipe is entered into the program), name (strawberry chiffon pie), source (*Joy of Cooking*), volume, and page number. If you like, you can type in the complete recipe with ingredients and instructions. References, entire recipes, ingredients, and instructions can easily be added, deleted, or changed.

A>Cook includes 500 recipe references from five popular cookbooks, including *Mastering the Art of French Cooking, Volume 1,* coauthored by Julia Child, and *The New James Beard,* by James Beard. You can add another 700 references for your own recipes, whether they are located in cookbooks, in a scrapbook with numbered pages, or in a numbered card file.

A>Cook starts you off with 90 categories and leaves another 200 up to you. For example, a recipe can be categorized by ingredients (nuts), food group (poultry), menu (dessert), or your own category (cheap). Like recipe information, categories can be deleted or

changed at will. A program option lets you scan the list of recipe categories on your disk.

The only drawback to the program is that you must initially enter the information for locating each recipe—no small task if you have more than 50 recipes for the index. And if you have fewer than 50 recipes in your repertoire, you might find *A>Cook* an impractical replacement for a well-organized card file.

However, *A>Cook*'s data management features make this program particularly attractive. You can retrieve any recipe or reference simply by specifying the appropriate category. Planning the week's shopping is made easier too, because the program will print a shopping list of all the ingredients needed for any combination of five recipes in the index. *A>Cook* will also do a little comestible "what if": if a recipe for six servings must be stretched to accommodate eight mouths, *A>Cook* will recalculate the amounts for all the ingredients.

In short, *A>Cook* makes cooking fun because it takes the organizational drudgery out of an essentially creative pursuit. You won't waste time wondering where Aunt Zorma's pound cake recipe is filed or worrying about dreaming up the right vegetarian dish for a potluck supper. *A>Cook* handles this and leaves you free to cook, eat, and enjoy. Ideally, home software will continue to enhance life's little pleasures. I just hope I'm still around when computers, in the guise of robots, learn to chop onions and wash the dishes.—*CW*

A>Cook: The Complete Computer Recipe System
East Hampton Industries, Inc.
66 Newtown Ln.
East Hampton, NY 11937
516/324-2224
List price: $40
Requirements: 128K, one disk drive

PC Abstracts

Are you having trouble finding that article about designer RAM chips? Are your fingers raw from riffling through hundreds of computer magazines? And are you tired of computer magazines that never publish a comprehensive yearly index? If so, *PC Abstracts* from FYI may be just what you're looking for.

PC Abstracts is a biannual disk-based readers' guide that includes abstracts—short descriptions—of articles from the top ten computer magazines. Articles can be retrieved quickly because they are indexed by "every significant word." The three-disk program includes an index, an indexing program, and a data base of abstracts. A one-page instruction sheet contains all the information you need to load the program, choose a task, and insert the proper disk when prompted. On-screen instructions lead you through the rest of this extremely friendly program.

Once *PC Abstracts* is loaded, you choose the Search and Find function from the main menu and type in the topics you want to retrieve. The program lets you search with thousands of different keywords and qualify a search with AND, OR, and NOT Boolean operators. The program also features Help and Browse the Index options. The Help option provides four screens of clearly written instructions on each of the program's features and includes a simple, comprehensive explanation of the Boolean search method. The Browse function helps you determine which keywords can be used to find an abstract. Browse will produce on demand a list of all keywords, keywords within a certain alphabetical range, or keywords that contain specified characters, such as *PC*. What would be helpful, but isn't offered, is an online thesaurus that could find keywords conceptually related to a word.

If you don't browse through the index before you start and enter a term that is not included in the index, the program offers a "mini-browse" feature. For example, entering **word processing** elicits the response 'Sorry, that's not in the vocabulary, these are close:' followed by a list of the 30 words alphabetically closest to that term in the

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COMPLETE SYSTEM OF TOOLS	• **Formula Calculator**—up to 26 variables. • **Visual Calculator**—with electronic paper tape. • **Intelligent Phone Dialer**—automatically inserts & dials access codes. • **Time Management**—visual calendar—detailed appointment notes. • **Alarm Clock**—unlimited chimes & visual signal. • **Full Correspondence Capability**—stores, edits, and prints notes and letters. • **Rubber Stamping Facility**—tags notes with time, date, etc. • **25 Built-in Business Formulas** • **25 Built-in Business Form Letters** • **Area Code Directory**	**NO** formula calculator. **NO** paper tape with calculator. **NO** intelligent dialing. **NO** detailed appointments. **NO** clock or alarms. **NO** correspondence storage. **NO** rubber stamps. **NO** formulas. **NO** form letters. **NO** area code directory.	**NO** formula calculator. **NO** paper tape with calculator. **NO** phone dialer. **NO** detailed appointments. **YES.** Alarm clock. **NO** correspondence storage. **NO** full-screen editing. **NO** rubber stamps. **NO** formulas. **NO** form letters. **NO** area code directory.	**NO** formula calculator. **YES.** Visual calculator. **NO** intelligent dialing. **NO** detailed appointments. **NO** clock or alarms. **YES.** Correspondence. **NO** rubber stamps. **NO** formulas. **NO** form letters. **NO** area code directory.
INTEGRATION OF FUNCTIONS	• **All tools work together**—All information is shared automatically or can be transferred instantly between tools. • **All tools use free-form storage.** • **All tools are fully user-tailorable.** • **Notes**—can be filed as appointments, or attached to calculations, reports or other notes. • **Telephone dialer**—searches file for phone number then dials. • **Alarm Clock**—triggers note recall when appointment comes up on calendar.	**NO** integration.	**NO** integration.	Partial integration—cut-and-paste required.
CONCURRENCY	• **META**—co-resides in memory with other programs. • Full one-touch program switching. • Appointments chime through other applications.	**LIMITED.** Will not chime through other applications.	**LIMITED.** Must load and quit from each function each time.	**NO** CONCURRENCY.

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WordStar	495	**198**	99
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Kpaint 1.07	100	**69**	20
Ktext 1.07	175	**123**	35
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R:BASE Clout	195	**129**	39
R:BASE Ext. Report	150	**99**	30
dBASE II	495	**279**	99
dGRAPH	295	**159**	59
Quickcode	295	**159**	59
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dBASE III Upgrade	200	**129**	
Quickcode III	295	**159**	59
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MicroSoft Project	250	**159**	50
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index. On that list is 'word-processing'—easily recognizable as the form you need to use. But again, this feature is only useful for finding words with alphabetic, not conceptual, relationships.

After the program makes its search (at approximately 60 abstracts per second), you can scroll through the selected abstracts or the article citations that match your search criteria. Either abstracts or citations can be printed out.

PC Abstracts also serves to demonstrate other FYI products and services. The company sells software that enables you to cross-index your own data bases and search and retrieve information from them. FYI also creates, publishes, and sells other private data bases in a form similar to *PC Abstracts*.

The only thing about *PC Abstracts* that makes me uneasy is its indexing methodology. Indexed significant words come not from an article but from its abstract—which may dilute the accuracy of the index. Nonetheless, *PC Abstracts* remains a useful and friendly tool for computer enthusiasts and researchers.—*DD*

FYI, Inc.
4202 Spicewood Springs Rd. #204
Austin, TX 78759
512/346-0133
List price: one-year subscription $149, two-year subscription $225
Requirements: 128K, two disk drives

Textra

Most software shoppers assume, often correctly, that an expensive package may be overpriced but a cheap one may not work very well, if at all. The ideal program, of course, should be fast, easy to use, versatile, and relatively inexpensive, but this dream is rarely fulfilled. However, *Textra,* a new word processor from Ann Arbor Software, comes close to fitting the bill on all counts.

Textra easily passes the first important test for any serious word processor: it keeps pace with a fast typist. Another plus is *Textra*'s use of function and cursor keys for most text manipulation, leaving few control sequences to remember. A wide range of text manipulation techniques puts *Textra* in the same league as *Microsoft Word* and *WordStar,* but at one-fifth the price. Considerable attention has been given to simplifying marking, copying, and moving sections of text. I wouldn't recommend *Textra* for the next *War and Peace* because it can process only a 20-page document. However, it can handle most of the memos, programs, letters, and short documents generated at home or in the office.

Textra comes from the what-you-see-is-what-you-get school of word processing software. A status line noting function and cursor key assignments is displayed at the bottom of the screen. Highlighting and underlining appear on the screen—a bonus for anyone who prefers to see results instead of the control characters that produce them. But *Textra* does not display page breaks, margin settings, or the cursor's line and column location. This information is instead managed with an on-screen electronic "ruler," as it is with a dedicated word processor. Although a ruler may sound unwieldy, *Textra*'s ruler is an effective visual formatting aid. Unfortunately, *Textra* limits a document to one ruler and thus to a single margin setting.

Textra's greatest limitation is document size. The entire program resides in memory and can't manipulate documents much larger than 30K; it does, however, display a percent gauge that alerts you to remaining available memory. *Textra* does not display a file directory, so be prepared to exit to DOS if you want to review what's on a disk.

Textra comes with an excellent graphics-oriented disk tutorial that leaves few unanswered questions. The tutorial is geared toward beginners and covers everything from booting up the program to printing out a document. *Textra*'s user manual is similarly clear and concise.

Ann Arbor Software makes a point of listening to its customers and is constantly updating the program. (Updates cost from $10 to $15.) The company even publishes a newsletter to keep *Textra* users posted on new developments. Given its cost, *Textra* compares favorably with the best of the old and new word processing standards. Don't let its low price put you off. This is one case in which there's more to a program than meets the checkbook.—*KD*

Textra
Ann Arbor Software
407 N. Main
Ann Arbor, MI 48104
313/769-9088
List price: $95.00
Requirements: 128K, one disk drive

Company Offers FREE OVERNIGHT DELIVERY!!!

New customer service policy expected to set a new standard in the mail order industry!

BY MICHAEL CHRISTOPHER

GARDEN CITY, N.Y.—Mr. David W. Pasternack, President of Logicsoft, a major IBM PC software and hardware distributor, has announced the inception of a unique new customer service policy. . . .free overnight courier delivery on their entire product line.

In a recent interview, Mr. Pasternack stated that "We feel our new free overnight delivery service will set a new standard in the computer software mail order industry. In a study we conducted, we found that in addition to competitive pricing, expedience was a factor utmost in our customer's minds. Whether their order was $300 or $3000, the need to get their package as soon as possible was the same. Under our old procedures, between processing and shipping time, it could take up to a week and a half to two weeks for an order to arrive. With our new courier service, an order can be processed, shipped,and arrive in our customer's hands in only 3 working days. . .at no additional charge!"

The company is using Emery Worldwide to handle the large number of packages being shipped each evening for next day delivery. "We chose Emery for their competitive pricing structure and excellent delivery record", said Mr. Pasternack. Emery was quoted as saying, "This makes Logicsoft the largest single Emery account in the New York Metro area.

LOGICTIP OF THE MONTH

Choosing software can be mind-boggling. With the proliferation of publishers, how do you choose. Analyze your needs. . . what specific tasks do you want to perform. Read the software reviews; an excellent way to evaluate a package. Ask around. . . you'd be surprised how many associates may be using a package similar to your application. Finally, choose the best package (not always the most expensive). Upgrading will end up costing you more. Remember the key word is research.

Logicsoft's Lowest Price Guarantee Still Effective

GARDEN CITY, N.Y.—Logicsoft, Inc. has indicated that their long time policy of guaranteeing the lowest prices in the mail order market is still being offered and will not be affected by their new free overnight delivery service. "We will continue to beat any price by $10" a company spokesman said. "We'd be crazy to fool with success", he stated; "since the inception of our lowest price guarantee, sales have skyrocketed."

When asked how Logicsoft could afford to give their customers free overnight delivery plus beat any price by $10, they replied "Buying Power". "Very simply", they said, we buy at the best possible prices and pass those savings along to our customers".

CONTINUOUS STATIONERY: BIG BUSINESS, But "Where's The Class?"

NEW YORK—The growth of Logicforms, Inc., a member of the Logic Group, has been phenominal. Mr. Ralph Corso, President of Logicforms explains why. "Up until now, buying continuous stationery through the mail has been a take what's available situation". "First off", he said, "almost all mail order firms offer only stock letterheads & envelopes with limited typestyles, colors and stock logos from which to choose, but, 'where's the class'?"

"The individual style and design of a letterhead", said Mr. Corso, "reflects the professionalism and personality of a company and should not have to change because they now have a printer and the need for continuous stationery. While other mail order firms are limited in the variety they can offer, Logicforms *specializes* in custom stationery. Logicforms offers a large selection of quality paper, ink colors and special effects such as thermography, blind embossing, foil stamping and multi-color printing." Mr. Corso went on to say that "whether a customer chooses to supply his own artwork or printed letterhead, *or* wishes to select from our vast array of stock designs. . .We are the Logical Choice".

For a free sample/pricing kit and a handy re-usable shipping envelope for artwork, simply call toll-free 1-800-645-3491 or send a sample of your current stationery for a free firm price quote. Mail to Logicforms, Inc., 300 Garden City Plaza, Garden City, N.Y.11530

TOLL-FREE SUPPORT A Smashing Success

GARDEN CITY, N.Y.—A survey of Logicsoft's toll-free technical support policy was done to see if it warranted the continued costs of the 800 toll-free number, personnel costs, etc. After careful monitoring of these calls (both pre-sale and after sale) it was found that 92% of the calls were for legitimate technical support questions rather than for answers already contained in the softwares' operations manual. As a result of the survey, the decision has been made to continue toll-free support as an important part of their customer service.

This service consists of assisting with: • Hardware requirements • Initial boot-up procedures • Initial software configuration (printers, disc drive, etc.) • Back-up procedures • Defective program determination • Alternative program recommendation • Return policy

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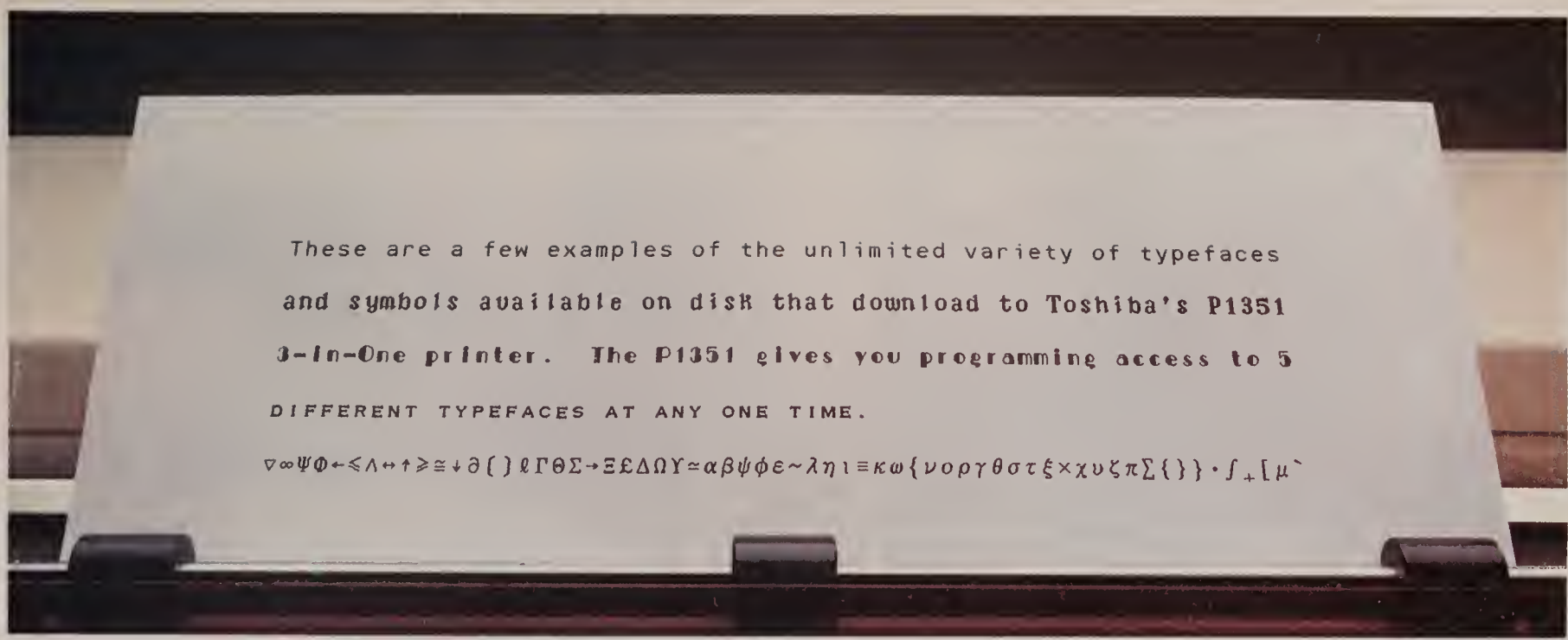

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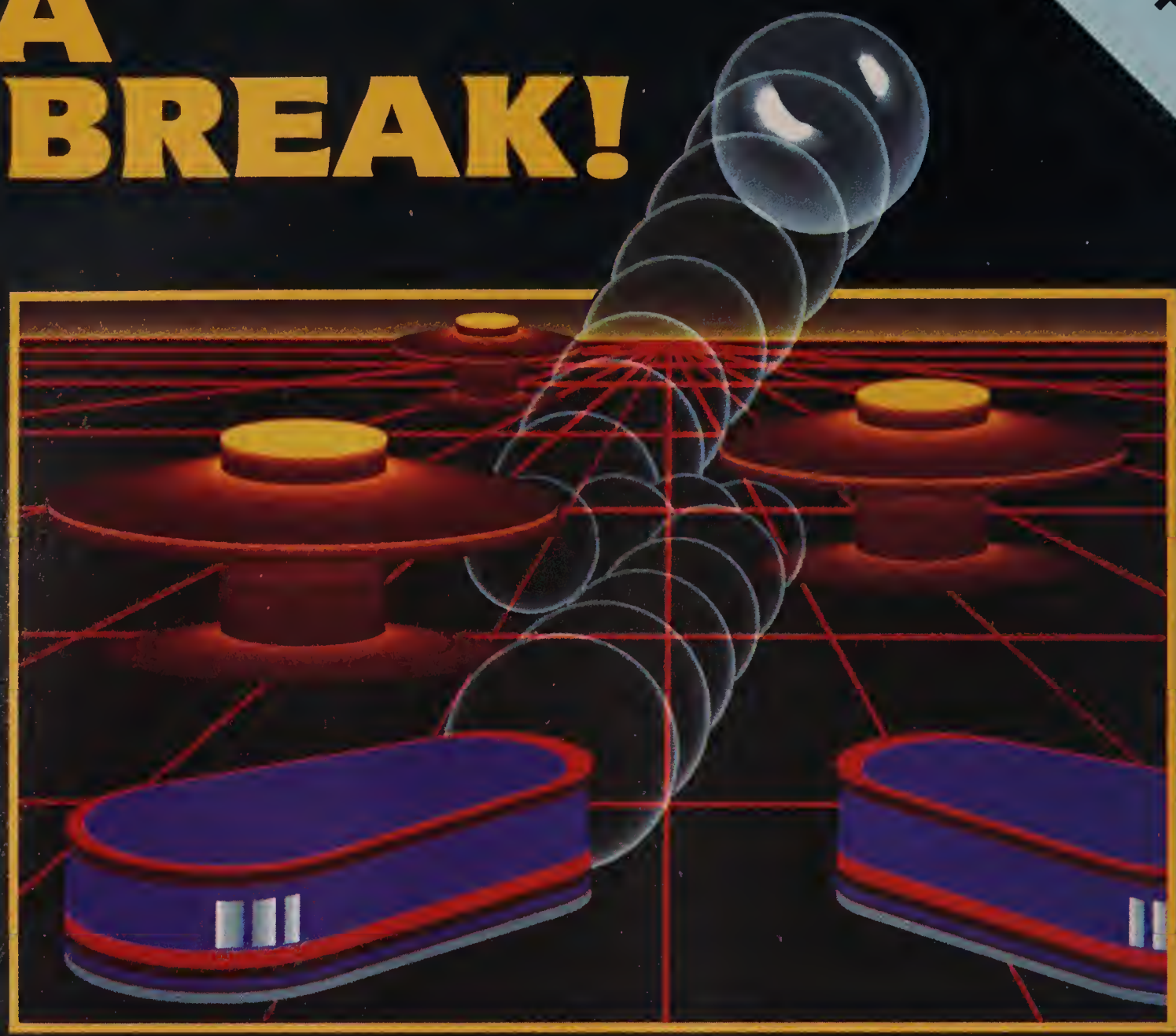

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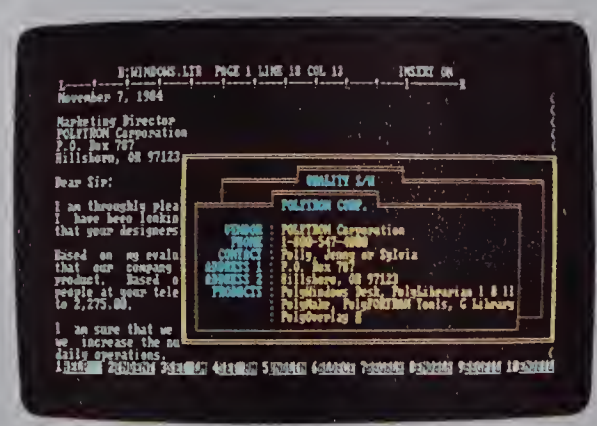

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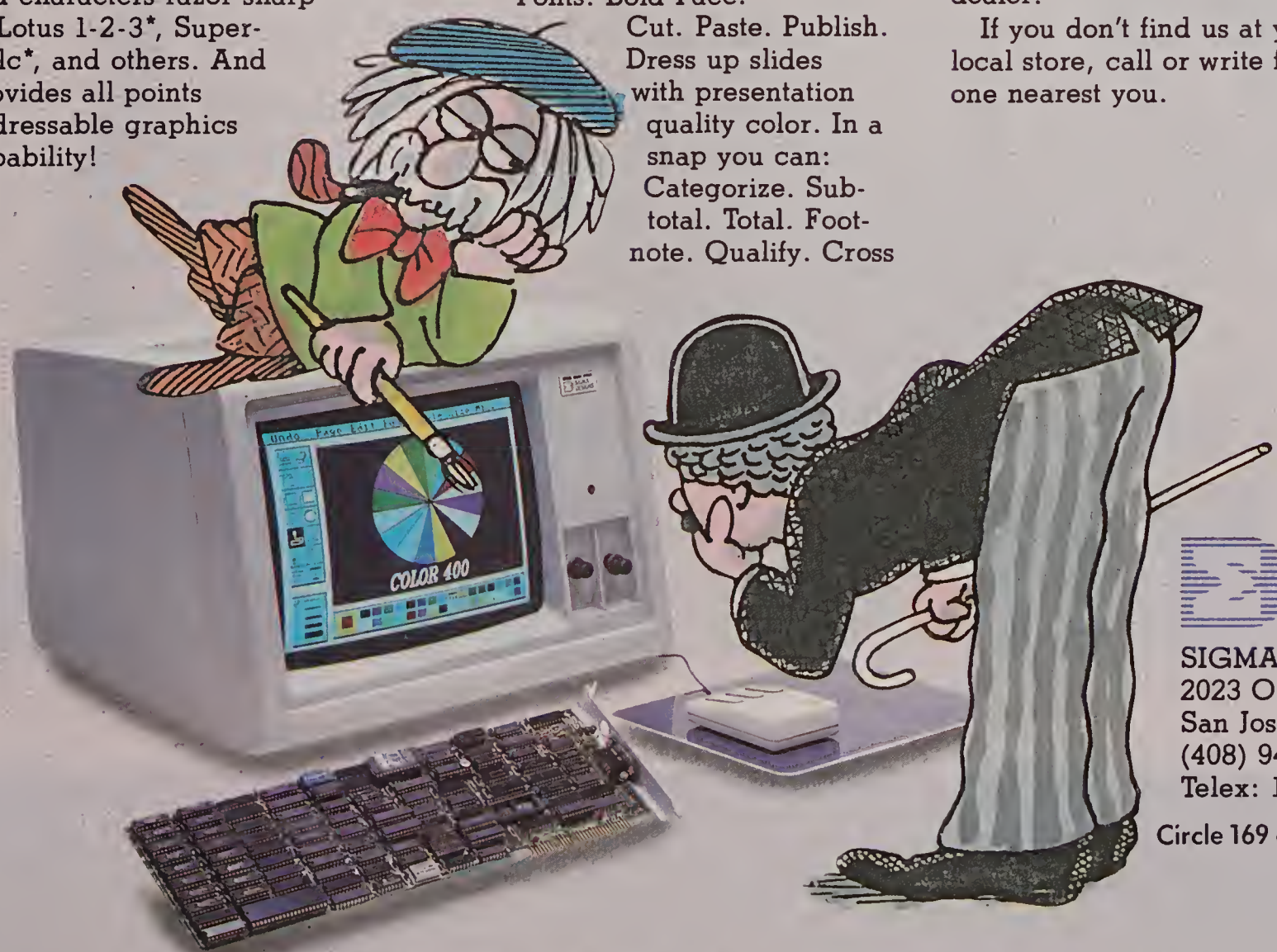

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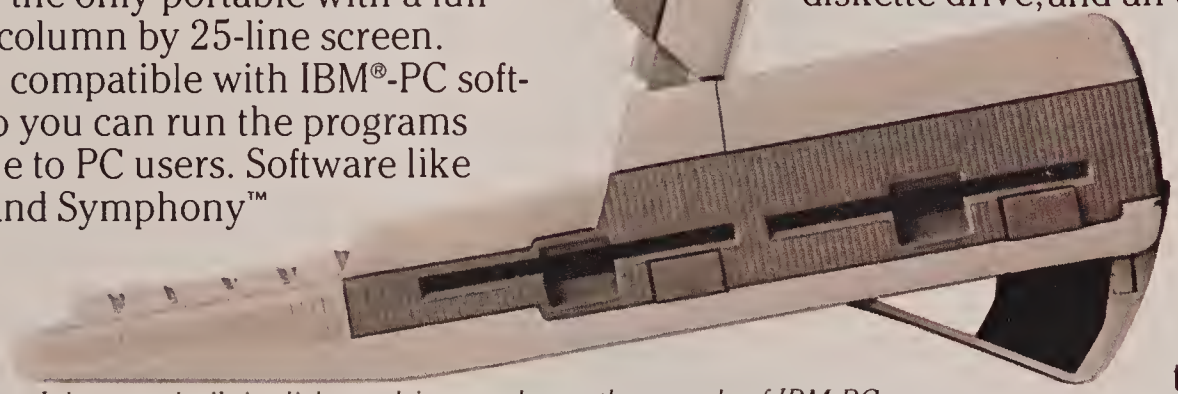

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PCjrWORLD

February 1985

The Home Computer Magazine
for People With PCjrs and Compatibles

Color on Command

Take Control of Jr's Expanded Palette

Use Cartridge BASIC's PALETTE statement to change colors in a flash.

Color on Command

Peter von Stackelberg

With computers, many things are possible. A leopard can even change its spots—if it's stored as a computer-generated image. The IBM PCjr's Cartridge BASIC includes a command—the PALETTE statement—designed to simplify transforming the color of a computerized leopard's spots or of any other computerized image. With the PALETTE statement's ability to change one color to another instantly, you can create special effects and do simple animation.

The Color Table

Several statements in PCjr's Cartridge BASIC, including LINE, CIRCLE, DRAW, PAINT, and PSET, enable you to draw and paint on the screen. A color number in the statement specifies the color to be used in the drawing. The PCjr's video circuitry searches a table for the color assigned to that number and produces an appropriately colored pixel.

Sixteen colors are available on the PCjr in medium-resolution graphics mode (SCREEN 5), each designated by a color number (see Table 1). Using the PALETTE statement, you can change the color assigned to a particular value in the table that the video circuitry consults.

Color Commands

To work with the PALETTE statement, plug the BASIC cartridge into the PCjr, turn the computer on, and load BASIC. Before you actually change any colors, you should set up a way of returning the computer's colors to their defaults. To create a "recovery button," type (in direct mode):

```
KEY 1, CHR$(27) + "PALETTE" + CHR$(13) < Enter >
```

This command assigns the string to the right of the comma to function key <F1>. When you press <Fn> <F1>, the computer reacts as if you had typed **< Esc > PALETTE < Enter >**. CHR$(27) is the ASCII value for the <Esc> key, which erases the line containing the cursor and sets the cursor in column 1. CHR$(13) acts as the <Enter> key, which tells BASIC to interpret and execute the instructions on that line—in this case, to execute the statement PALETTE. In this format (without additional parameters) the statement restores the color assignment for each color attribute to its default setting. The full format of the PALETTE statement is

PALETTE [*attribute*][,*color*]

where *attribute* is the color number you want to change and *color* indicates the color to be assigned to *attribute*.

To see how the PALETTE statement works, type the following lines, pressing <Enter> at the end of each line.

```
5    REM ******EXAMPLE 1******
10   CLEAR ,,,32768: SCREEN 5: CLS
20   LINE (20,20)-(300,180),4,BF
30   INPUT; "Press < Enter > ",A$
40   PALETTE 4,1
```

Line 10 clears extra video memory for the medium-resolution graphics mode, SCREEN 5. A large red box is drawn on the screen by line 20 of the program; its color is specified by the number 4. Line 30 instructs the computer to wait for you to press <Enter> before it proceeds with the program. In line 40, the PALETTE statement assigns the color blue (the value 1) to color attribute 4. Thus the red box changes to a blue box.

Now that you've changed the value of 4 from red to blue, all subsequent graphics statements that use the color attribute 4 (whose default value is red) will instead produce blue images.

Clear the screen by typing **CLS** and pressing <Enter>. Now type:

```
CIRCLE (90,180),20,4: PAINT (90,180),4,4 < Enter >
```

After you press <Enter>, a blue circle should appear at the bottom of the screen. Notice that the color attributes used to draw the circle and paint its interior were both 4—usually the value for red—yet the circle is blue on the screen. This happens because the PAL-

Adding Some Flash

The PALETTE statement can be used to create special effects and animate drawings on the PCjr. Lights can flash, objects disappear, buildings explode–almost anything can happen right before your eyes. The Cartridge BASIC program CASTLE.BAS illustrates some of the visual effects that you can create.

Before you begin, clear the last program from memory by typing **CLS:NEW** **< Enter >** and press <Fn> <F1> to set the computer's colors back to normal. Then type in CASTLE.BAS (see CASTLE.BAS in *Listings* at the back of this issue).

When you run the program, a castle is drawn on the screen. The sky is black, a lightning bolt is drawn across the sky, and the lights in the castle are lit.

Press the <Space> bar to see the same scene in the daytime. The lightning bolt disappears. The sky turns blue, and the lights in the windows go out.

Press the <Space> bar again. Suddenly night falls. The sky is black, and the lights in the castle come on. Then lightning strikes in the sky. Pressing the <Space> bar makes the lightning flash again. Pressing L turns the lights in the castle on and off. To quit, press the letter Q.

The PALETTE statement was used to create all these special effects. Lines 10 through 690 of the program use the LINE, CIRCLE, and PAINT statements to draw and color the castle, the mountain, and the lightning bolt. The textured patterns on the tower roofs and the mountain are done with paint tiling.

In line 700 of the program, the INPUT$ statement tells the computer to wait for you to press any key before proceeding. Line 710 turns

CASTLE.BAS draws a picture of a castle on a mountain. With the PALETTE statement you can turn night to day.

off the lights in the castle by changing the yellow pixels to cyan. Line 720 changes the sky from black to blue, and line 730 changes the white lightning bolt to blue, making it invisible against the sky. With blue sky and the lights off in the castle, the scene looks like daytime.

The INPUT$ statement in line 740 again instructs the computer to wait for you to press any key before it continues the program. The scene then changes back to nighttime. The lights in the castle are turned on by line 750, which restores the windows to their original color.

Line 760 of the program changes the lightning bolt, drawn with pixels of attribute 15 (bright white), to black so it remains invisible against the night sky. (If line 760 were omitted the lightning bolt would be visible in blue against the black sky.) In line 770 the PALETTE statement changes the entire sky to black, making night appear to fall. The mountain is changed from a textured green to a pattern of gray by line 780. We originally painted the mountain with a pattern of green and gray, but the bright green dominated the picture, and the gray was hardly noticeable. When the green pixels are changed to black by line 780, the gray pattern stands out.

Line 790 changes the white outline of the castle to black to maintain the illusion of nighttime. The value of the variable LC (for light counter) is set in line 800. The delay loop in line 810 keeps the night scene undisturbed for a few seconds.

Then . . . flash! A lightning bolt illuminates the entire night sky. This is done with the PALETTE statements that start at line 830. Line 830 turns the lightning bolt to bright white. The delay loop in line 840 keeps the bolt white for a brief time. The entire sky is then turned bright white by line 850. The delay loop in line 860 keeps the sky white momentarily before the PALETTE statements in lines 870 and 880 turn the sky and the lightning bolt black again. Because the whole process of creating the flash is inside a loop, it repeats, creating flicker in the flashes.

The INPUT$ statement in line 900 keeps the computer waiting for a new command. If you press the L key, the computer jumps to the subroutine that starts at line 940. This subroutine determines the value of the variable LC (which was initially set to 14 in line 800). The IF . . . THEN statement in line 940 makes it possible to switch back and forth between two values. If LC equals 0, it is reset to 14. If LC already equals 14, then the value is set to 0.

The PALETTE statement in line 950 uses the value of LC to switch the color of the windows between yellow and black. The RETURN in line 960 returns BASIC to the next statement after the GOSUB in line 890, where the GOTO 900 sends BASIC back to line 900.

Line 930 determines whether the <Space> bar was pressed. If it was, BASIC jumps back up to line 820, and another lightning flash occurs. If the key that was pressed was not the <Space> bar, BASIC is sent back to line 900 to wait for another key to be pressed. Line 920 determines whether the Q (Quit) key was pressed. If it was, the program resets the color attributes to their default color assignments and ends.

Value	Color
0	Black
1	Blue
2	Green
3	Cyan
4	Red
5	Magenta
6	Brown
7	White
8	Gray
9	Light Blue
10	Light Green
11	Light Cyan
12	Light Red
13	Light Magenta
14	Yellow
15	High-Intensity White

Table 1: Attribute numbers for the 16 colors

ETTE statement in Example 1 assigned the color blue to the color attribute 4 and registered that color in the table.

Suppose you change your mind and don't want blue to replace red. To return the colors to their default settings, you can use the function-key command you set up as your first step. Press <Fn> <F1>. The word PALETTE will appear on the screen, and all blue pixels will become red.

Now modify the program in Example 1 so that it will restore the default color assignments. Type these two lines:

```
50  INPUT " again",A$ < Enter >
60  PALETTE  < Enter >
```

Run the program again. The red box will change to blue and then to red again.

Using Variables

More than one color at a time can be changed with the PALETTE statement. Clear the last program from memory by typing **NEW < Enter >** , and type the following lines (again pressing <Enter> at the end of each line):

```
5   REM ******EXAMPLE 2******
10  CLEAR ,,,32768!:SCREEN 5:CLS
20  FOR A=1 TO 15
30     CIRCLE (A*21-11,100),10,A
40     PAINT (A*21-11,100),A,A
50  NEXT
60  INPUT;"Press  < Enter > ",A$
70  FOR A=1 TO 15
80     PALETTE A,14
90  NEXT
```

We will reuse this program later, so type **SAVE "EXAMPLE2"** and press <Enter>. When you run the program, 12 circles will appear on the screen in colors ranging from blue (the default value of 1) to bright white (the default value of 15) (see Figure 1). These circles are drawn by the loop that starts at line 20 of the program. Because the value of the variable *A*—which is used as the color attribute parameter for the CIRCLE and PAINT statements—increases in steps from 1 to 15, 15 circles of different colors are drawn.

Now press <Enter>. The circles are all changed to yellow by the loop that starts at line 70. Because the variable *A* is used as both the counter in the loop in line 70 and as the color attribute to be assigned a new color (14, or yellow) in line 80, the color attributes through 15 are each assigned the color yellow. On the first cycle through the loop, *A* has a value of 1, so the PALETTE statement changes all the pixels that have a value of 1 (those in the first circle) to yellow. On the second cycle through the loop, *A* has a value of 2, so all the pixels with a value of 2 are changed to yellow. This process continues until all 15 attributes have been assigned the color yellow.

Although all the circles have been painted yellow, they have not all been painted with pixels with a value of 14. The first circle is still composed of pixels with a value of 1, the second of pixels with a value of 2, and so on, but each value has been assigned the color yellow. To change the fourth circle (which is composed of pixels with a value of 4) to bright white (value 15), simply use the PALETTE statement with the appropriate parameters. To do this, type **PALETTE 4,15 < Enter >** . The computer remembers that the circle is composed of pixels with a value of 4.

Other Screens

All the programs used so far have been written for SCREEN 5, but the PALETTE statement works with all of the PCjr's other graphics modes and with text mode. For example, in SCREEN 2 (high-resolution graphics), which usually displays white on black, you can substitute any of the available 16 colors for white. Let's take a quick look at this. Press <Fn> <F1> to

Figure 1: The program in Example 2 draws circles in each of the 16 colors available in SCREEN 5. With the PALETTE statement you can instantly change the color of any circle or even make a circle appear to move across the screen.

reset the colors to normal, and then type **CLS:NEW** and press <Enter> to clear the screen and remove the last program from memory. Now type the following lines, pressing <Enter> after typing each line:

```
5    REM ******EXAMPLE 3******
10   CLEAR ,,,16384: SCREEN 2: CLS
20   LINE (200,75)-(420,125),1,BF
30   INPUT;"Press < Enter > ",A$
40   PALETTE 1,4
50   INPUT " again",A$
60   PALETTE 0,1
```

When you run the program, a white box is drawn in the middle of a black screen. Press <Enter> and the box changes to red. Press <Enter> again and the black background changes to blue.

Animating With PALETTE

The ability to change colors quickly and easily makes simple animation possible. With the second sample program, you changed the color of a series of circles. Think about what would happen if all those circles were black (invisible) instead of yellow and you made each circle visible for only an instant. It would appear that a single circle was moving across the screen. To see this, type **CLS:NEW < Enter >** to clear the screen and remove the last program from memory; then press <Fn> <F1> to set the colors back to normal. Type **LOAD"EXAMPLE2" < Enter >**. Then type the following lines, pressing <Enter> after each line:

```
5    REM ******EXAMPLE 4******
80   PALETTE A,0
100  FOR A=1 TO 15
110     PALETTE A,4
120     FOR B=0 TO 100:NEXT
130     PALETTE A,0
140  NEXT
150  GOTO 100
```

When you run this program, a line of circles of different colors appears on the screen, just as when you ran Example 2. But when you press <Enter> something different happens—all the circles disappear and a red circle moves across the screen. Press <Fn> <Break> to stop the program. Then press <Fn> <F1> to restore the default color assignments.

Type **LIST** to take a look at how the program works. The loop that starts at line 70 and includes the PALETTE statement in line 80 changes all the circles to black, the color of the background, making them invisible.

The animation effect results from making a circle visible for an instant, changing the color of that circle back to black, and then making the next circle visible momentarily. The loop that starts at line 100 changes the circle colors in the proper sequence.

Circles are used in this sample program because they are quick and simple to draw. However, you could, for example, create a walking person by designing a set of images with the arms and legs in different positions and placing the images in a line across the screen. The principles used to animate the circle work just as well with images that are shaped differently. (See "Adding Some Flash" for an example of more sophisticated animation with the PALETTE statement.) You'll find that the control offered by PALETTE and Cartridge BASIC's other graphics statements opens up a wide field of possibilities for useful—and entertaining—graphics applications.

Peter von Stackelberg is an author and programmer who lives in Edmonton, Alberta, Canada.

An extra disk drive and additional memory give the PCjr extra PC compatibility.

A Drive to Succeed

Seth Novogrodsky

When the PCjr was announced, many observers were disappointed by its limited capabilities. Yet several hardware manufacturers saw the possibilities presented by the PCjr's limitations. Today PCjr owners have many options for expanding the capabilities of their computers. Rapport Corporation has entered the market with a line of PCjr expansion products dubbed Rapport Companions. The line's lead product is the Drive Two Enhancement Package, which adds a second disk drive to the enhanced PCjr and enables it to emulate the functions of the IBM PC.

When snapped onto the top and side of the PCjr system unit, Drive Two provides a second double-sided disk drive, a parallel printer port, and a clock/calendar with battery backup. A switch on the unit permits you to select whether the computer should function as a PC or a PCjr. The package includes its own power supply. A 128/384KB Memory Expansion Package is an option offered with the Drive Two package to bring the Jr's RAM up to as much as 512K.

The Pieces

Aesthetically, the Drive Two package blends in very well with the PCjr system unit (see Figure 1). In fact, Rapport even provides a sticker for the unit reading "Top unit built by Rapport/Bottom unit built by IBM" to prevent people from thinking that the unit is actually part of the IBM machine. The Drive Two package consists of a Top Assembly, which contains the disk drive and optional memory expansion board, and a Side Assembly, which contains the parallel printer port and an expansion bus extension. Once assembled, the entire unit is about 3 inches taller than the unaugmented PCjr.

The Qume disk drive in the Top Assembly is nearly identical to the

Figure 1: The Drive Two Enhancement Package snaps onto the top and side of the PCjr, adding a second disk drive and extra memory.

one supplied by IBM. Drive Two's power transformer is also quite similar to the one supplied by IBM. It consists of a black rectangular block, connected by cords to a three-pronged outlet and to the Top Assembly. The Rapport and the IBM power transformers can even be interchanged.

The 128/384KB Memory Expansion Package consists of two printed circuit boards that fit into the Drive Two Top Assembly. Although the 128/384KB Memory Expansion Package is sold separately, it can be used in only the Drive Two package. The board has 128K installed and sockets for another 256K, giving the 128K PCjr a complement of at least 256K RAM with a possibility of 512K.

Setting Up

The Rapport press material claims that the Drive Two Enhancement Package can be installed "in less than ten minutes." This estimate may be a bit optimistic. Unless you are technically inclined, you might consider having your dealer install the hardware and initialize the software. A good dealer will provide this service at little or no charge.

Fitting the Memory Expansion Board in the Top Assembly was no easy task. The first step involves plugging in the Extender Card, which connects the board containing the memory chips to the PCjr's bus. It took me about ten minutes just to snap the Extender Card in place. I had to bend two plastic brackets in the Top Assembly before I could position the board properly.

After I installed the Memory Expansion Board in the Top Assembly, the next step was to snap the Top Assembly onto the PCjr system unit. It fit like a glove, and the rest of the installation was very straightforward, aided by concise and well-illustrated documentation. The documentation complements the PCjr system as neatly as the hardware does; it is designed to fit into the PCjr's *Guide to Operations* manual.

Software for Switching

The Drive Two package comes with a disk that contains the programs required to take advantage of the enhancements. PCVIDEO.COM, which you are instructed to place in an AUTOEXEC.BAT file, allows the PCjr to run PC programs that could not normally be executed on the PCjr because of the way display memory is allocated. SETCLK.EXE sets the clock/calendar, and POW2CLK.EXE, placed in the AUTOEXEC.BAT file, initializes the system clock each time the computer is turned on. A mysterious program called SPEEDER.COM is on the disk but is not mentioned in the documentation. A Rapport technical representative informed me that SPEEDER.COM, if executed twice, will increase the PCjr's performance by changing the way its memory is allocated; the program causes the PCjr to use the lower 128K as an I/O (data input/output) buffer.

The disk also includes a set of printer utilities, RAPLPT2.COM and RAPLPT3.COM. The Drive Two's printer port is configured to work as PRN: or LPT1:. To use the port as LPT2: or LPT3: you must place one of these two programs in a CONFIG.SYS file. The documentation describes how to create the needed AUTOEXEC.BAT and CONFIG.SYS files using EDLIN, the DOS editor.

Test Driving the Drive

Once I completed the setup, I set about testing how well the Drive Two Enchancement Package succeeded in boosting the PCjr's capabilities to that of an IBM PC equipped with two disk drives and 512K of RAM. Using the computer in the PC emulation mode, I successfully ran *WordStar*, version 3.3, and *1-2-3*, version 1A, with graphics—both are programs that are incompatible with the 128K PCjr. I was also able to run both DOS 1.10 and 2.00 without any errors, although IBM does not support these operating systems on the PCjr because of the somewhat longer head-settling time required by the PCjr's half-height disk drive. Both MicroPro International, supplier of *WordStar*, and Lotus Development Corporation, supplier of *1-2-3*, are now marketing versions of their programs specifically tailored to the PCjr, but not all software developers are following suit. The PC emulation mode is probably the most important feature of the unit; it opens up a much larger library of programs to PCjr users.

However, the Drive Two Enhancement Packgage does not turn a PCjr into a PC. Not all software packages designed for the PC will run on a Rapport-equipped PCjr. The disk drive in the Rapport unit is controlled by the PCjr's drive controller, which is not the same as the one supplied with the PC. Although both controllers make use of the same NEC drive controller chip, the PC's drive controller uses a feature called direct memory access, which results in much faster performance. Programs that require this feature will not run properly on the PCjr.

The PC emulation mode is probably the most important feature of the unit; it opens up a much larger library of programs to PCjr users.

There is another limitation: Even when the PCjr is equipped with the Rapport units, it still runs programs more slowly than the PC does. For example, in *Word Star* I frequently type a number of commands in rapid succession. On the PCjr, *WordStar* cannot always keep up with me. The machine beeps indicating that the keyboard

buffer is full and cannot accept another character. Also, the screen displays images more slowly because of the way the PCjr allocates display memory. Another noteworthy limitation is that a 512K PCjr has less available user RAM than a 512K PC because, unlike the PC, the PCjr allocates a section of RAM to the video display. Parity, a standard feature on the IBM PC and XT but not on the PCjr, is not provided by Rapport along with the additional memory. Parity is an error-checking technique in which an extra bit is attached to each byte to check if the byte has been unintentionally altered.

In the Marketplace

Rapport designed its Rapport Companions series to give the PCjr the features that made the PC such a success (and the absence of which were almost PCjr's undoing). The line of Rapport Companions also includes the Drive One Enhancement Package, which converts an entry-level PCjr into an enhanced model, and a group of peripheral products including a speaker system and a keyboard adapter cable that permits you to use any PC-compatible keyboard with the PCjr.

Since the introduction of the Rapport units, however, IBM has introduced its own products to achieve the same results, adding a more commercial keyboard and offering extra memory and a RAM drive. Rapport's success depends on how it compares with other manufacturers in filling the gaps left by IBM.

The Drive Two Enhancement Package is priced competitively with the PCjr expansion devices that are available from companies such as Legacy, Falcon, and IBM. Unlike IBM, Rapport offers a second disk drive, and Rapport's 128/384KB Memory Enhancement Package is considerably less expensive than IBM's memory expansion attachment for the PCjr, especially since the IBM units require an additional $150 power supply to bring the PCjr up to 512K. Of course, the Rapport Memory Expansion Board can be used only with the Drive Two package.

In general the Rapport Drive Two Enhancement Package succeeds admirably, bringing the PCjr into an entirely new league of personal computing. The unit is well designed and generally easy to install. It lifts the PCjr to a respectable level of PC compatibility and effectively confers upon the PCjr *almost* all the capabilities of its namesake, the PC.

Seth Novogrodsky is a Contributing Editor for PC World *and* PC World Books.

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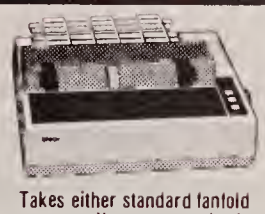

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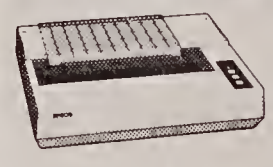

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viously). Plus, the new dictionary includes a document word-count feature and the ability to search entries using any letter in the word.

this fall we can expect new WordPerfect features such as table of contents and index generation

PC Magazine

Right on time.

WordPerfect 4.0 features automatic generation of indexes and five types of tables, including table of contents. You simply mark words to appear in the desired tables, and generation is accomplished with just one keystroke.

Footnoting is a good example of WordPerfect's sensible style.

Business Computing

Sensible, but not good enough.

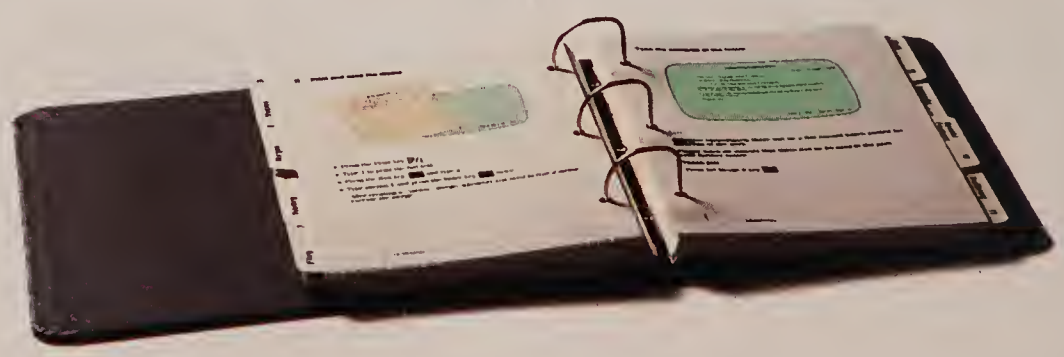
The same footnoting capabilities garnering much praise for WordPerfect are even more enhanced in WordPerfect 4.0. Now lengthy footnotes can span multiple pages, and footnotes can be placed either at the bottoms of pages or at the end of the document. In fact, footnotes and endnotes can both be used in a single document.

Earlier versions of WordPerfect were plagued with poorly organized documentation.

Softalk Magazine

We agree.

The documentation for WordPerfect 4.0 reflects a great deal of reorganization and improvement. Following a number of suggestions

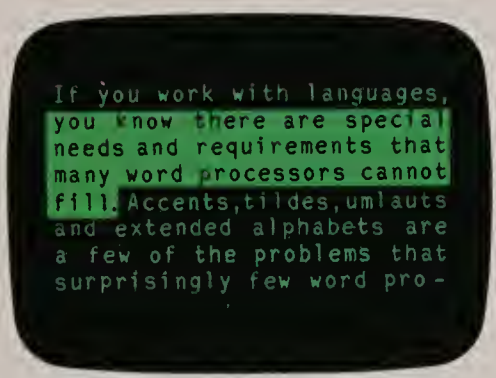


ighest marks yet.

from users and after extensive testing of the new format, SSI is excited to introduce this significantly enhanced documentation package. Many new diagrams have been added and tutorials are more extensive. In addition, the reference section is expanded and better organized for ease of use.

The program does not adequately mark text slated for deletion or movement. The block ought to be highlighted,

InfoWorld Magazine



Makes sense.

A new block highlight feature of WordPerfect 4.0 lets you know exactly what block of text you have defined.

The program would be enhanced if it regularly saved text to disc

InfoWorld Magazine

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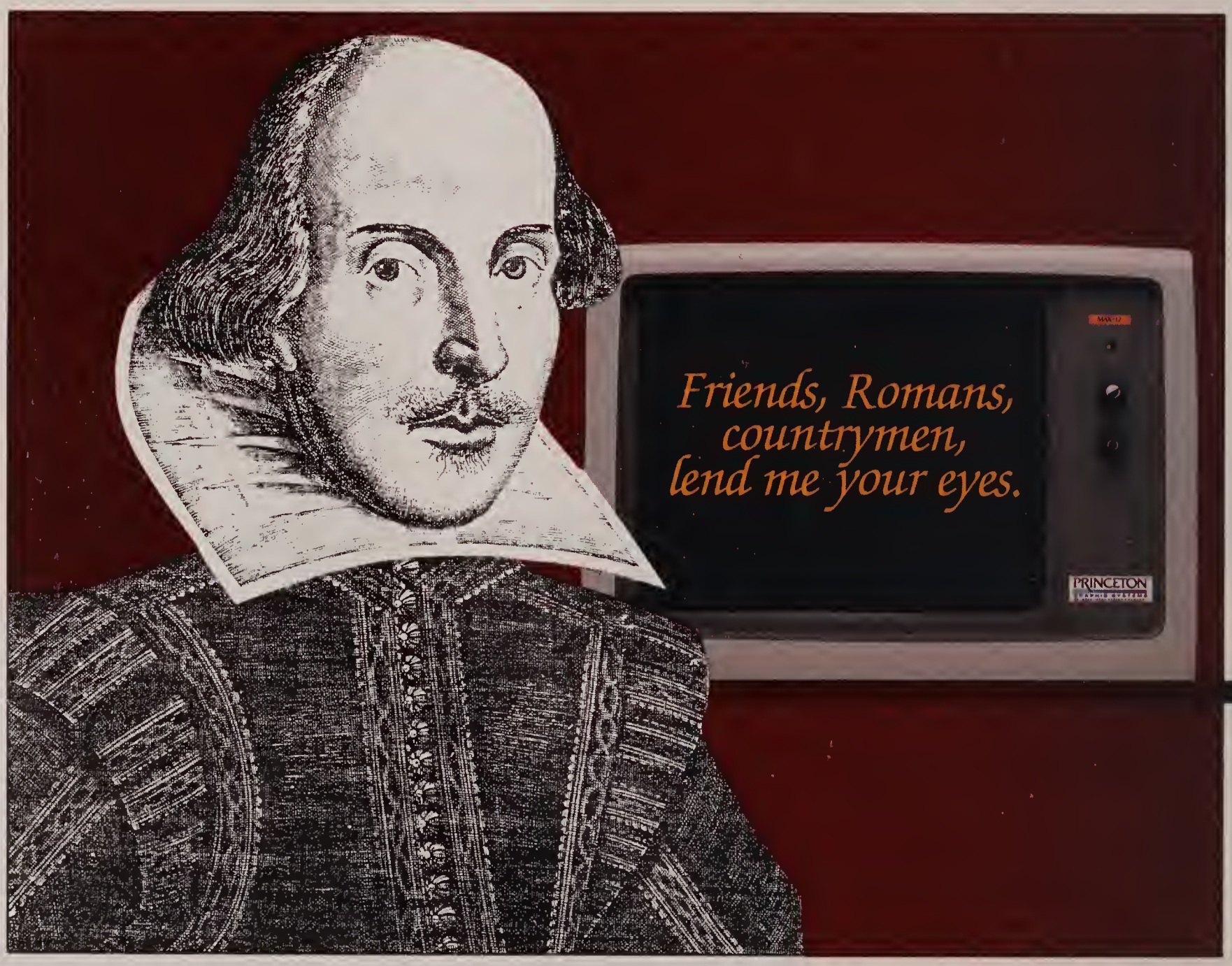

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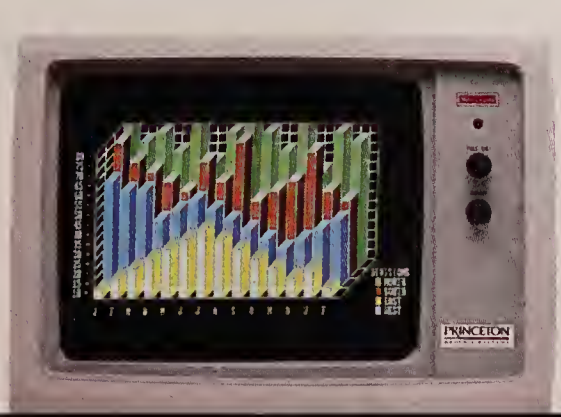
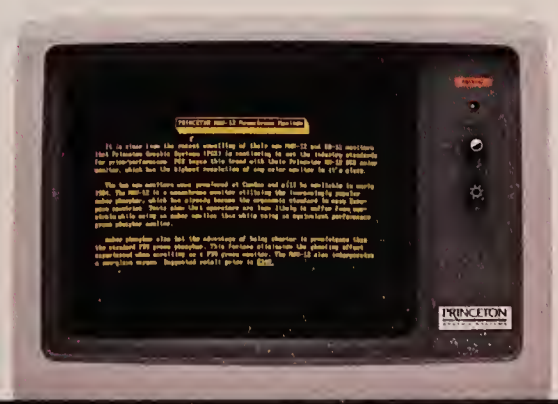
The PRINCETON HX-12 RGB color monitor, with a dot pitch of .31mm, offers the finest resolution in its class. The HX-12 delivers 16 crisp, sharp colors including clean whites without color bleed—a not-so-easy accomplishment in an RGB monitor.

Price All Princeton monitors set the price/performance standard in their class. The SR-12 at $799 compares favorably with monitors costing hundreds more. The HX-12 is in a class by itself at $695.

The PRINCETON MAX-12, with easy-on-the-eyes amber phosphor, sets the standard for monochrome monitors at $249. The MAX-12's dynamic focusing circuitry ensures sharpness not only in the center but also in the edges and corners. And it runs off the IBM PC mono-card—no special card is required.





All three monitors feature a non-glare screen and an IBM compatible cable. A PCjr adapter cable is also available for the HX-12. And to see your Great Ideas from the best possible angle, you can put your Princeton monitor on the Princeton Undergraduate Tilt and Swivel Base for only $39.95. **Or, while supplies last, get the Undergraduate FREE with the purchase of a MAX-12 monitor.**

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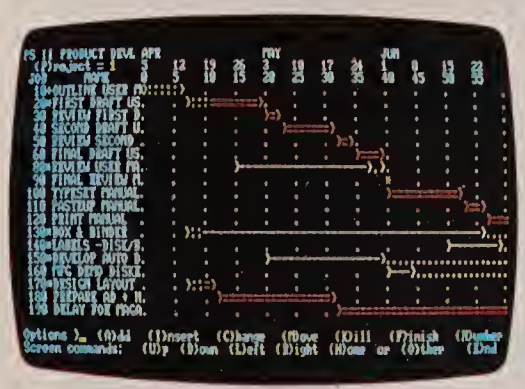

Mainframe Power — Personal Computer Simplicity

Project Scheduler 5000 brings mainframe capabilities to your personal computer. You can schedule over 5000 activities spread over 10,000 time periods. What this means is that you can manage the largest projects with ease. While you probably don't need this power on a daily basis, it's nice to know that you have room to grow.

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Project Scheduler 5000 gives you all the information you need when you need it. Instantly, you know the status of your project. At a glance, unique plot symbols will let you know whether or not the project is on time and if not, why.

Project Scheduler 5000 keeps you constantly informed through its partial complete capabilities. Partial complete status is displayed, reported and used to calculate "value earned".

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Extensive resource categories allow you to schedule more efficiently. Using these categories, you can assign to an activity an almost limitless amount of resources. In addition, these resources can be assigned at any point within the activity timeline providing the accuracy you need to build realistic resource profiles by person, labor grade, or other types.

Integration Of Multiple Projects

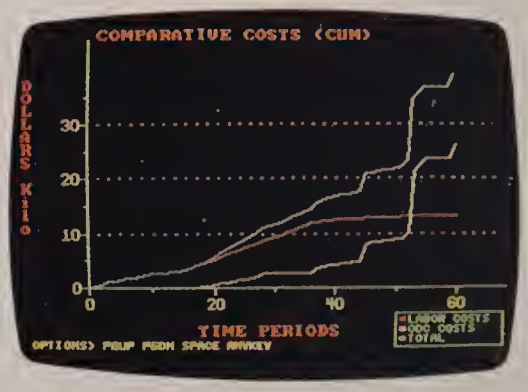
Keeping track of how a resource is used from project to project can be extremely difficult. Not with Project Scheduler 5000. The program can combine projects to give you a complete overview of where and when resources are used. Think of it! You can simultaneously manage several projects and be on time and meet or beat cost projections on each one.

Fast Comprehensive Reporting

Communicating project information is no longer the time consuming task it used to be. An enhanced report generator synthesizes project information into reports on resource allocation, status, schedule and cost at both the project and the detailed activity level. You can interactively define special reports to give you all the detail you need. Reports and Gantt plots can be printed on hard copy, plotted, or stored on disk for future use. Additionally, a spreadsheet interface provides labor and cost transfers for further analysis.

Integrated Graphics Power

Project Scheduler 5000 plus Graphics complements the outstanding scheduling and reporting features provided by Project Scheduler 5000. Using presentation quality financial line graphs, resource histograms, resource bar graphs and other high impact displays, Project Scheduler 5000 plus Graphics provides additional insight as you study in depth the



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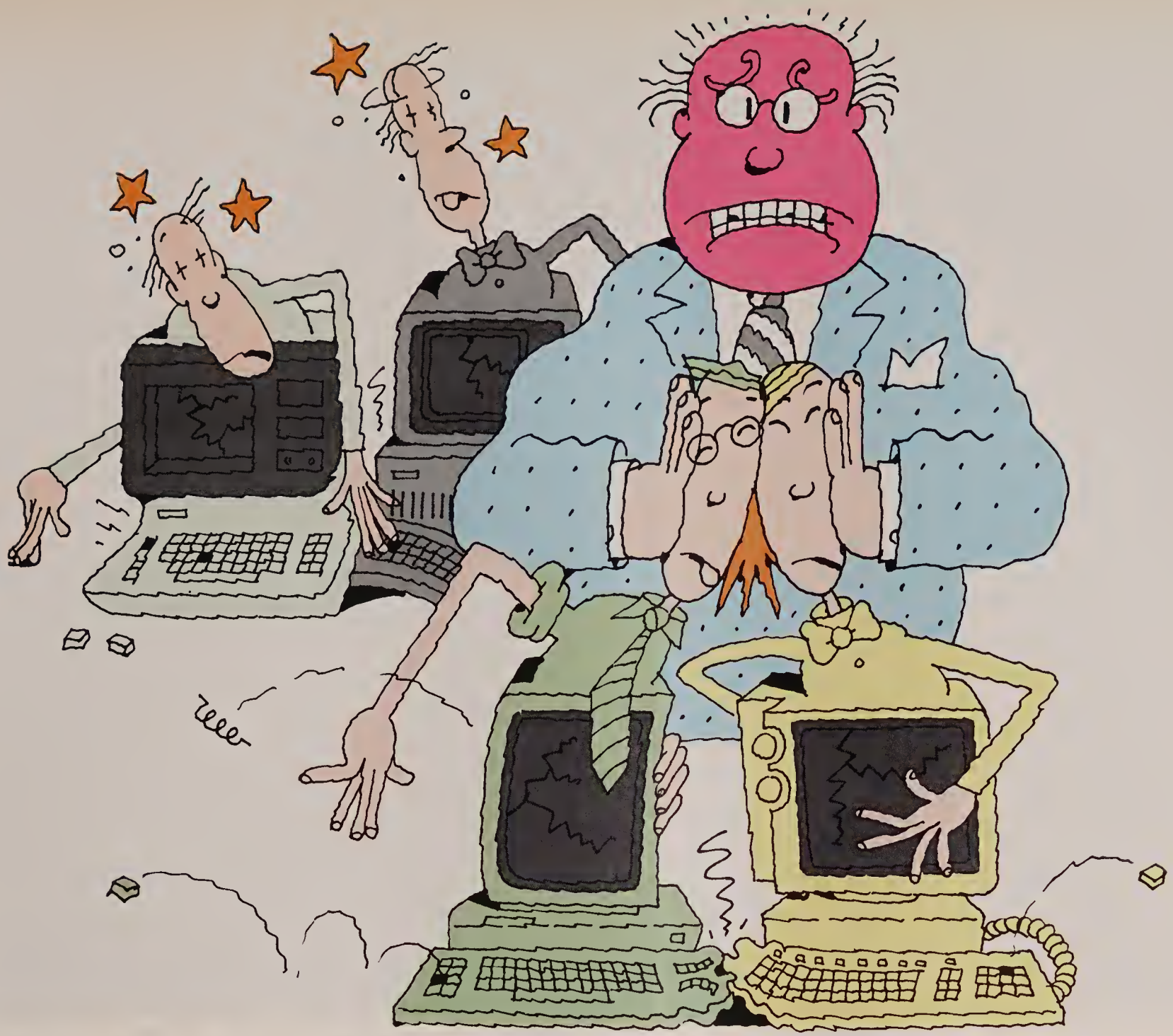

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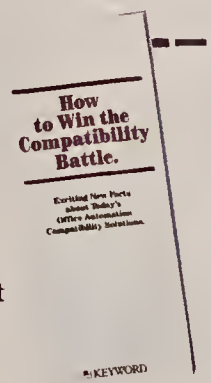

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But what about the people who have to use it?

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Industry publications like PC Magazine have written about those problems.

And now, more than twenty states are currently preparing special computer legislation to force some changes.

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They usually know a lot about technology but very little about people.

Which is why so many computers often are technically impressive yet strangely unnatural to use.

Computer-induced problems (%)	
Eye strain	55%
Back pain	43%
Headaches	30%
Shoulder	25%
Hand/wrist	18%
Neck pain	15%

(Source: "Ergonomic Principles in Office Automation" Pub. 1983 by E.I.S. AB, Sweden.)

The result has been a whole range of computer-induced problems ranging from stress and fatigue to blurred vision.

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It's this:

That the machine is the servant of man.

Not the other way around.

That excellent ergonomic design isn't a privilege.

It's a right.

That ergonomics isn't just a noble gesture.

It's good business.

Because computers are only as fast and as accurate as the people who operate them.

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This attitude has made Ericsson No. 1 in Europe twice over:

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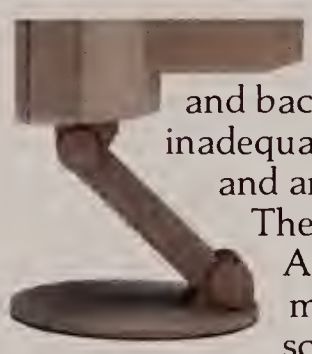

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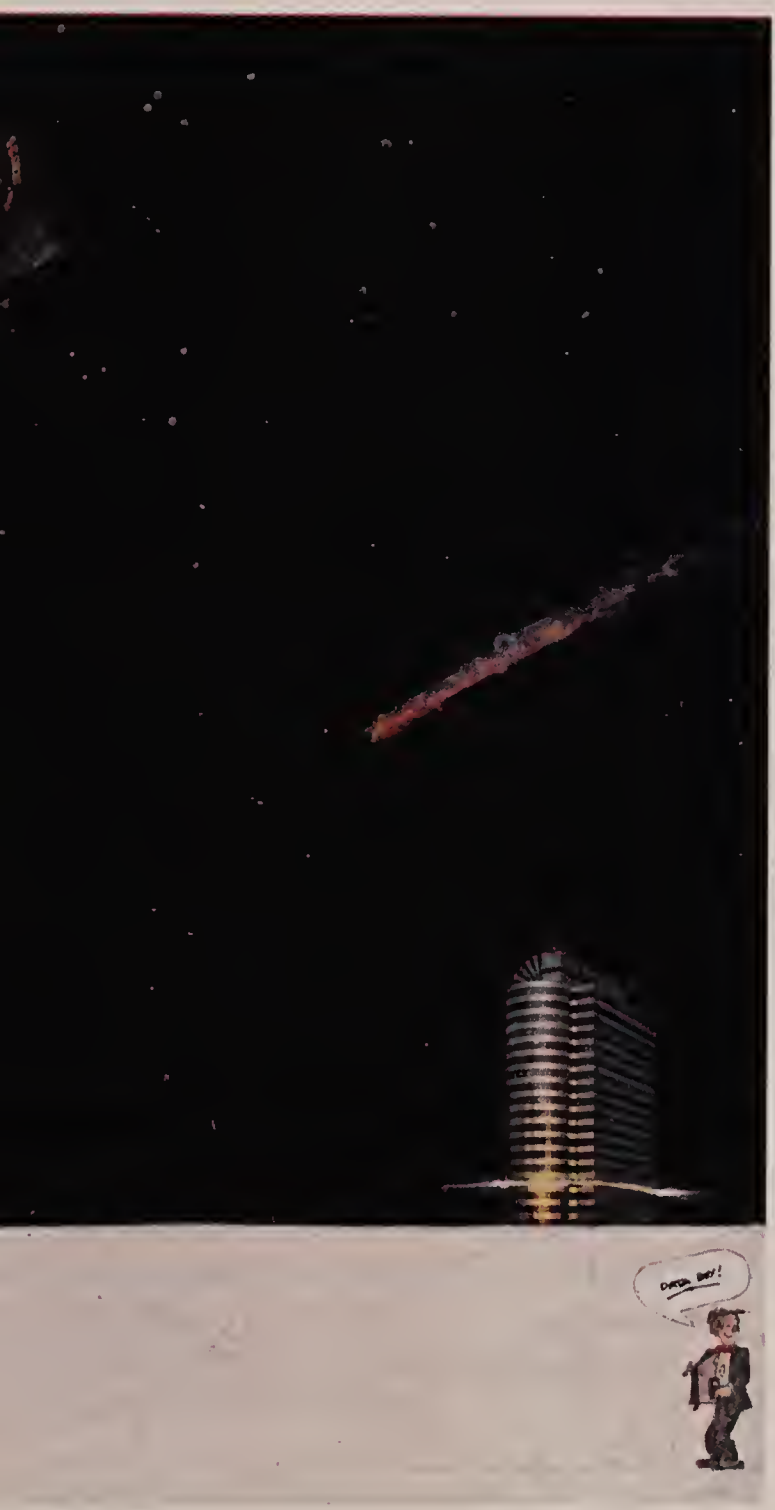
A New Focus on Data Management



Data management comes of age as a major mainframe system moves to the PC, dramatically increasing data accessibility and flexibility and decreasing programming time. PC/Focus signals a productive new trend in managing data.

Warren Sirota

In personal computer time a "generation" is little more than several ticks of the clock. Sit back and wait a few minutes, and you'll witness the debut of some flashy new breed of systems, peripherals, or software. These entrants are intended to supplant their predecessors by dazzling users with their versatility, affordability, and indispensability. Unfortunately, some products hailed as generational shifts show more flash than functionality.

Not so with programming languages. In the language realm, generations coexist and "breakthroughs" take longer to break through. So when a fourth-generation programming language becomes available for the PC, it's cause for special notice—perhaps even celebration. *PC/Focus*, from Information Builders, incorporates such a language, and the product heralds a new era in data management.

A Higher-Level Language

Fourth-generation programming languages succeed such "high-level" third-generation languages as FORTRAN, BASIC, and Pascal. In the mainframe world, fourth-generation languages have been recognized for some time as a major boon to productivity. The most prominent of these are NOMAD 2, RAMIS, and Focus. Until *PC/Focus*, however, there was no intersection of this type of language with personal computing.

PC/Focus is a full-featured PC-based implementation of the dynamic mainframe system. It brings to the PC an unprecedented level of control in data management and data manipulation. Although not for everyone, *PC/Focus* signals a move toward software friendly enough to understand (if not speak) your language. While many existing data management products offer some of the capabilities of *PC/Focus*, none contains features as comprehensive and integrated. The product is equipped with a tool kit imported from the system's mainframe origins that has left precious few components behind, making access to information flexible and easy.

Products of *PC/Focus*'s generation validate the concept of the "information resource"—the notion that an organization's attitude toward data, including the method of monitoring it and maximizing its use, is almost as important as the data itself. With *PC/Focus* a company can manage its information resource as a unit rather than as separate elements belonging to distinct applications. Complex ad hoc inquiries, including those that require reports and graphs, can be satisfied with unmatched ease.

A Generation Gap

As different as BASIC and FORTRAN may be from one another, they—and all third-generation languages—share a key limitation: none can address a unit of data larger than a record. A fourth-generation language, by contrast, can be instructed to operate on an entire file. This enables you to communicate with the computer in a language closer to English.

Communication at the record level (as in third-generation languages) requires you to describe in precise detail not only what data you want retrieved but how retrieval must occur. The difficulty is that we tend to think in terms of files, whereas a third-generation language "thinks" in terms of records. When using that type of language, if you want a sorted report from a file, you must describe on a record-by-record basis exactly how the sort must be done. A simple "List all customer addresses by last name" will not suffice.

This emphasis on following a specific sequence of steps is the reason third-generation codes are also called procedural languages. Fourth-generation languages, however, do not require detailed descriptions of various procedures; hence, they're often referred to as nonprocedural languages.

PC/Focus *is a full-featured PC-based implementation of the dynamic mainframe system. It brings to the PC an unprecedented level of control in data management and data manipulation.*

Nonprocedural languages make ad hoc inquiries easy to process. They also abbreviate various aspects of programming itself, allowing substantially shorter programs. Because far fewer commands are required when addressing data at a file level, programs written in nonprocedural languages are simpler and less expensive to write, contain fewer errors, and are easier to modify than programs written in third-generation languages.

Most data management packages that include a programming interface incorporate a few features of nonprocedural languages. *dBASE II*, for example, creates a default data entry format. You're given one field per line, with the field name an automatic label, and you enter data on the rest of the line. You're thus freed from having to deal with detail at a field level. Still, if you've ever tried to obtain a spreadsheetlike list with vertical and horizontal totaling from a *dBASE II* data base, you know that certain types of ad hoc inquiries can be difficult to handle.

A Potent Import

In its mainframe incarnation, Focus carries a $110,000 price tag. The program is used at more than 1000 organizations, representing some 150,000 individual users. In modifying the product for the PC, Information Builders has sacrificed only Focus file size and speed of program execution.

Even with those limitations, *PC/Focus*, at $1595, is data management on an exceptionally ambitious scale: records can contain up to 250 fields (more than 4K); files are limited only by disk drive capacity; a full-screen program editor named TED is built-in; and the program can write files in .DIF format. *PC/Focus* comes on 11 disks and takes up 3.5MB of disk storage.

Accordingly, you need a "loaded" PC or XT to run *PC/Focus*. The software won't run with less than 512K of RAM, and 768K is recommended. (The PC's traditional maximum user RAM is 640K. If you begin with 256K, you can reach 768K by adding a Focus accelerator board. The board is equipped with 512K and contains routines that can access the extra RAM.)

PC/Focus requires more time to learn than most other data management products, chiefly because of its abundance of tools. The initial cost of the program and the memory upgrade may seem to limit *PC/Focus* to corporate settings. Yet if your business requires a programmer to do coding, *PC/Focus* might be a solid investment. For a large programming project, *PC/Focus* is apt to save enough in programming fees to pay for itself—and for the extra hardware it requires.

Data Definition

A nonprocedural language such as *PC/Focus* simplifies programs greatly, because it enables you to build key relationships into the data bases themselves. This frees you from having to maintain these relationships with program code. You can design applications that, in a sense, have "fewer moving parts"—and therefore rarely fail (see the discussion under Manipulating a Data Model).

PC/Focus users won't need to refrain from tinkering with a piece of code or a data item for fear of disturbing a complex web of program-defined relationships. Data can be defined in a way that enables *PC/Focus* to perform automatically many of the data-matching functions that would otherwise be accomplished by complex programming. (Such data matching functions automatically link fields in two or more files. Data matching might relate those files through a code common to several fields.)

Data relationships between files, for example, can be made part of the file definitions themselves, and that ultimately means a more reliable data management system. All fourth-generation data base managers are capable of automatically maintaining cross-indexes among files, permitting you to scan a record in one file and fields from related records in several other files simultaneously. You can cross-index simply by naming the fields you want to see. If the data base is designed properly, you can change values in any of the records from any of the files you're viewing in an ad hoc manner—with no risk to subtle relationships that a programmer may have created among files.

PC/Focus includes a full set of relational operators. A relational operator is a large-scale method of combining two existing files into a new file that performs matching operations between records in the first file and records in the second. Relational operators—which represent another example of a fourth-generation "file level" command (versus a third-generation "record level" command)—enable you to extract records from the new file (if the values in the fields match up, of course). Such functions give you the ability to build new data bases from old ones in precise ways and permit the creation of new data relationships among existing data.

Reports to Order

To enhance the query and reporting process, *PC/Focus* includes an exceptionally powerful report generator that requires just a few lines of code to create custom-formatted multifile reports. The key to this power is the Table command, a simple but high-level report generator that includes enough subcommands to constitute a language in itself.

To help you master this command, *PC/Focus* features an intelligent front end called TableTalk (see Figure 1). TableTalk, which isn't part of the mainframe Focus, consists of a set of menus that enable you to quickly and effectively extract information and produce reports from *PC/Focus* data bases—without having to learn the program's query commands. TableTalk lets you choose the file to use, the

fields to list, and the fields to summarize by simply using cursor keys to highlight menu choices. These choices are translated into the syntax of Table commands, which are displayed in the lower portion of the screen.

TableTalk accesses all Table subcommands, except those formatting commands that control the precise positioning of lines on the printed page. To prepare a report for printing, you need to learn the relevant Table commands.

You can create a report in the form of a *PC/Focus* data base, which can be manipulated still further. If you're an advanced user, this capability gives

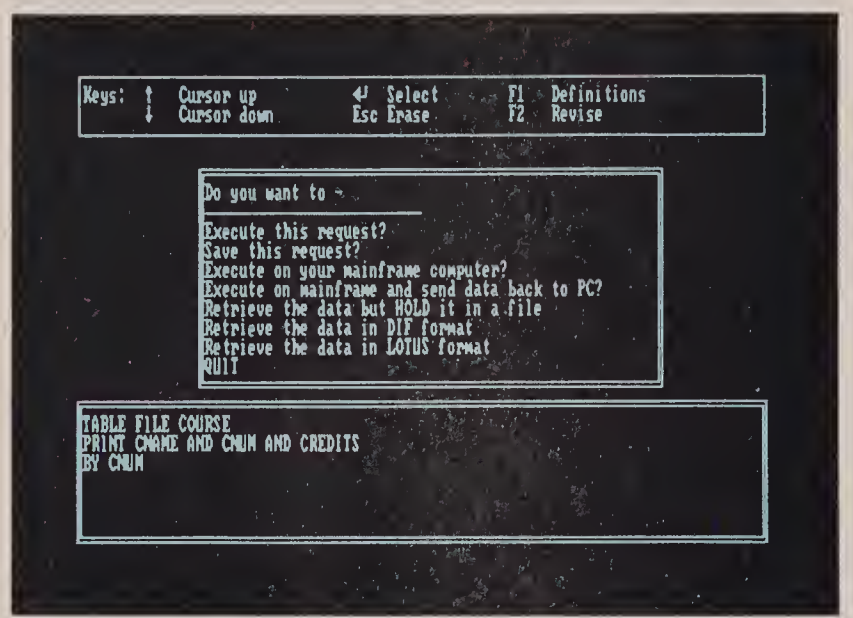


Figure 1: The PC/Focus TableTalk interface, which can be used to generate a Table command. The Table command performs the actual work of report generation.

you extra flexibility when attempting sophisticated analyses. It enables you to put data in whatever form seems most meaningful. Take census data, for example: Creating a data base that lists everyone's income wouldn't make sense. A better approach would be to create a summary data base consisting of average income by city or congressional district. *PC/Focus* makes short work of that selective chore.

The *PC/Focus* report writer can operate on files created by other data management programs, by spreadsheet programs, and by most programs written in BASIC or Pascal. The only prerequisite is that you must describe the record layout of the "imported" files to *PC/Focus*—that is, specify how many bytes to read in and interpret, based on how the record is written. From then on, the usual *PC/Focus* file-level commands apply.

Features to Spare

PC/Focus offers a wealth of additional features that, working together, make it a formidable product. A list of these features follows.

Mainframe communications. Because *PC/Focus* is essentially the same as its mainframe counterpart, data can easily be transferred between the two (assuming, of course, that you have a modem attached to the PC). You could use a PC or an XT for data input and local processing and then update a mainframe Focus data base. In another scenario, corporate users could develop Focus applications on a PC without incurring substantial time-sharing costs. If large quantities of data required processing, these applications could then be run on a mainframe.

Application creation. Here, *PC/Focus* offers several tools. Its Dialogue Manager allows programmers to create full menu-driven applications, and its Let command enables you to design a macro language. The FileTalk utility helps you design files easily with an interactive question-and-answer interface similar to TableTalk. The Check File command generates diagrams of file relationships.

Integrated graphics. PC/Focus generates bar, pie, and line charts with a range of variations and special formatting options.

Data base administrator facilities. These features enable a "master user" to encrypt files and determine security procedures. Passwords can be required for read or write access on any level—from entire data bases to values in fields.

Virtual data fields. This feature permits you to define a field that isn't actually stored as such. *PC/Focus* calculates the virtual field using the values of other fields or lookups into other files. Because their values are contingent on other fields, virtual fields are valid only as output. A "total price" virtual field could be derived from unit price fields, for example.

Statistical analysis capabilities. PC/Focus offers virtually all the capabilities of a dedicated statistical analysis program, including standard deviations, multiple regression, analysis of variance, and time series analysis.

Financial modeling language. The program's report generator includes an extension that expedites the production of financial reports.

STUDENTS

SSN	LNAME	FNAME	ADDRESS
111-22-3333	Beck	Walter	485 Main St.
123-33-1234	Saunders	Carolyn	181 Phobos Ave.
762-83-7463	Levi	David	342 Jupiter St.
839-23-1324	Kobayashi	Tan	1422 32nd Ave.

COURSES

CNUM	CNAME	CREDITS
MAR200	Conversational Martian I	3
MAR201	Conversational Martian II	3
MAT482	Advanced Differential Eqns	4
MUS401	Music of the Cubes	3
PHY984	Astral Geophysics	3
PSY563	Psych of Extraterrestrials	3

ENROLL

YR	SEM	CNUM	SSN	GRADE
84	Fall	MAT482	111-22-3333	B+
84	Fall	PHY984	111-22-3333	A
84	Fall	PSY563	111-22-3333	A
84	Fall	MAR200	762-83-7463	A
84	Fall	MUS401	762-83-7463	C
84	Fall	PHY984	762-83-7463	A
83	Spring	MAT482	123-33-1234	A

CNUM	CNAME	SSN	LNAME FNAME	GRADE
MAT482	Advanced Differential Eqns	111-22-3333	Beck, Walter	B+
PHY984	Astral Geophysics	111-22-3333	Beck, Walter	A
PSY563	Psych of Extraterrestrials	111-22-3333	Beck, Walter	A
MAR200	Conversational Martian I	762-83-7463	Levi, David	A
MUS401	Music of the Cubes	762-83-7463	Levi, David	C
PHY984	Astral Geophysics	762-83-7463	Levi, David	A

Figure 2: The relational approach to data management, conveyed via portions of three Land Grant University data bases. The Enroll table is the "relation" between the Students file and the Courses file, because each row links one student's social security number (SSN) with one course number (CNUM). Before reports are printed, the data can be "joined" (with the Join command) to produce a table similar to the composite shown, which illustrates student grades achieved in courses taken during the fall semester of 1984.

Designing Applications

A company's records are vital resources for decision making. Proper data base design ensures that information recorded today for one purpose can be used tomorrow for a different purpose. Because the automation of an enterprise is usually a long-term proposition, structuring data so that it is useful for unforeseen future purposes makes sense. In addition, a good data base design permits easy access to the data, minimizing the chances for error, the amount of disk space the data consumes, and the cost and effort of programming.

The two most popular models for data base design are the relational and the hierarchical. Unlike *dBASE II,* which is only relational, *PC/Focus* can handle relational and hierarchical data bases—as well as data bases that have elements of both.

Figure 2 illustrates how the relational model works. (For this example we're monitoring students and courses at Land Grant University, a small midwestern school.) In such a model, information is kept

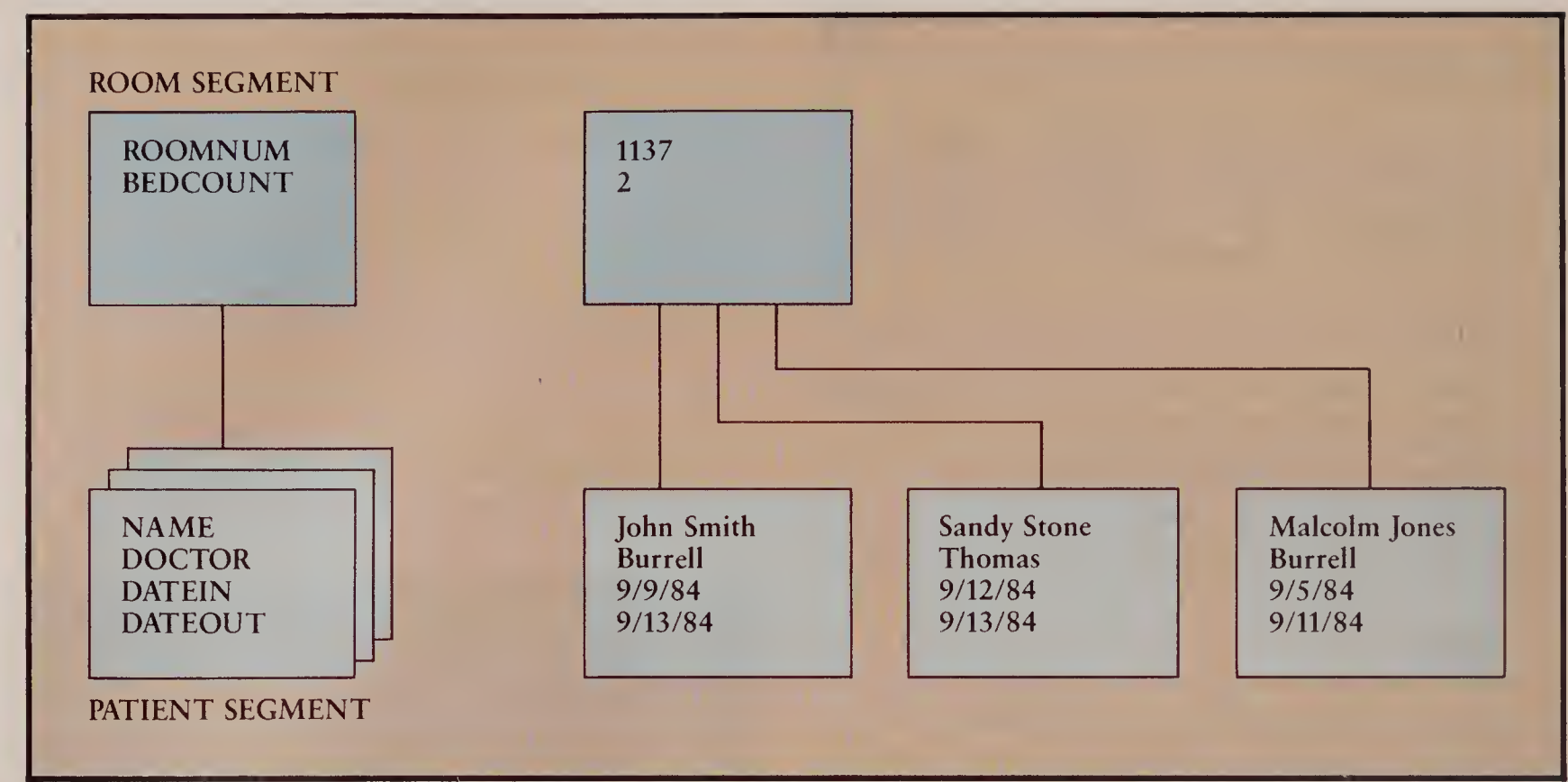


Figure 3: The hierarchical approach to data management, which is particularly appropriate when a many-to-one relationship exists (such as many patients, over time, to one hospital bed). The boxes suggest the structure of a data base that could keep track of bed occupancy. Each room is designated by a Room Segment that contains the room number and the number of beds in the room. Associated with the Room Segment are several Patient Segments, which list the individual occupants of the room. The room number is not kept in the Patient Segment, because it is implicit in the Patient Segment's position as a "child" of the Room Segment.

in tables. One table is dedicated to keeping track of students, and one tracks courses. A third table follows the relationship between them; in effect, it answers various queries: Which students attended which courses? When did they do so? What grades did each of them receive? The third table does not duplicate any information in the student and course files (such as a student's name and address). Instead, it contains "key fields"—notably, the student number and the course number—which act as the glue that binds the three files together.

When it's time to produce grade reports, you can create a single *PC/Focus* file that contains information from the three separate files. This is generally achieved with a Join command, which you can append with "filtering" options that limit the information contained in the final file. To produce grade reports for a given semester, for example, you would use the Join command and a clause instructing *PC/Focus* to include only records for that semester in the final file.

In a hierarchical data base, by contrast, data is organized into parent-child relationships rather than in tabular form. Hierarchical models tend to require less memory to store each record than do relational models. Figure 3 is a conceptualization of a hierarchical data structure that a hospital might use to monitor patients and beds. At the top level is a record structure that accommodates each room, including both the room number and the number of beds in the room. Each room record can have several records as its "children" (representing the patients who occupy beds in the room). There's no need to store a room number in the patient's record, because the room number is implicit in the position of the patient as a "child" of the room. Although seemingly a small matter, this approach can save substantial disk space. The hierarchical model is ideal when such "many-to-one" relationships abound.

```
TABLE FILE ENROLL
HEADING CENTER
"LAND GRANT UNIVERSITY"
"<SEMESTER> <YR>          <CNAME>  <CNUM>"
"</2"
PRINT LNAME AND FNAME
BY CNUM NOPRINT  PAGE-BREAK
BY SSN
IF SEMESTER EQ 'FALL'
IF YEAR EQ 84
END
```

```
                 LAND GRANT UNIVERSITY

 FALL    84           ADVANCED DIFFERENTIAL EQNS                MAT482


 SSN          LNAME            FNAME
 ---          -----            -----
 111-22-3333  BECK             WALTER
 123-33-1234  SAUNDERS         CAROLYN
```

Figure 4: The code shown here produces the Land Grant U. grade roster. To print field names in the page heading, you must use angle brackets (<>) as delimiters. '"</2"' tells PC/Focus to skip two lines after the heading. The program begins a new page every time the course number (CNUM) changes. The IF clauses print records only if they pertain to the fall semester of 1984.

Manipulating a Data Model

Let's return to our Land Grant U. example to see how *PC/Focus* handles a hybrid of the relational and hierarchical models and produces reports from exceptionally concise instructions. Suppose old Land Grant U. wanted to develop a registration and grade-tracking system for its students. Such a system should be capable of producing class rosters and grade reports, such as those shown in Figures 4 and 5. How should the school structure the data?

There are essentially two "entities" in this project: students and courses. When a student takes a course in a given semester, a grade results. The grade is a "relationship" between two Land Grant U. entities. It is best to store the data as three files: One file, called Students, contains student information but includes nothing about courses (this file could also be used for billing purposes); another file, called Courses, consists of course information but contains no data about students; a third file, called Enroll, includes information about the relationships between students and courses. Figure 6 shows the layout for each file as you would describe it to *PC/Focus* (including the cross-references from the Enroll file to each of the other files).

To maintain this type of system, you need some sort of unique identifier as a key field in files about entities. Each student in the Students file is identified by social security number, and each course in the Courses file is identified by a unique course code. This unambiguous way of identifying a student and a course makes it easy to establish a relationship, such as Enroll, between the two entities.

By defining the Enroll file as shown, you can automatically access any recorded fact about a student or a course when you use that file. This is also where the Table command comes in, so you might want to refer to Figures 4 and 5 for the *PC/Focus* code necessary to produce class rosters and individual grade reports.

One sure sign of poor data base design is redundant data. Each piece of information—except for the key identifier fields such as social security number and course code—should appear only once in a data

```
DEFINE FILE ENROLL
  GRADEVAL/F8.2 = DECODE GRADE ('A+' 4.25 'A' 4 'A-' 3.75 'B+' 3.5 'B' 3
        'B-' 2.67 'C+' 2.33 'C' 2 'C-' 1.67 'D+' 1.33 ELSE 0) ;
  POINTS/F8.2 = GRADEVAL*CREDITS ;
END



TABLE FILE ENROLL
HEADING CENTER
"LAND GRANT UNIVERSITY"
"<LNAME , <FNAME                                <SSN </2"
PRINT CNAME CREDITS GRADE POINTS BY SSN NOPRINT PAGE-BREAK BY CNUM
IF SEMESTER EQ 'FALL' IF YEAR EQ 84
ON SSN COMPUTE GPA = POINTS/CREDITS ;
END




                         LAND GRANT UNIVERSITY
          BECK, WALTER                              111-22-3333


 CNUM    CNAME                                   CREDITS  GRADE    POINTS
 ----    -----                                   -------  -----    ------
 MAT482  ADVANCED DIFFERENTIAL EQNS                    4  B+        14.00
 PHY984  ASTRAL GEOPHYSICS                             3  A         12.00
 PSY563  PSYCH OF EXTRATERRESTRIALS                    3  A         12.00

 ** GPA                    3.80
```

Figure 5: The code that produces the grade reports here is more complex than that shown in Figure 4. (The first example "decodes" the letter grade, representing it as a number, and defines grade points; the second generates the grade reports themselves.) The Define statement dynamically creates two new variables in the Enroll file, named Gradeval and Points. Gradeval is the numerical value of the letter grade kept in the file, and the Decode subcommand is an easy way to make this association. The number of points earned is defined as the value of the grade times the number of credits earned. The code that actually produces the report is similar to the code used to produce grade rosters, except that the 'ON SSN COMPUTE' clause prints a summary of the newly defined GPA (grade point average) field every time the social security number changes.

base. If you have to reenter Tommy Smith's address into a record every time he signs up for a course, you've designed your data base improperly.

Nonprocedural languages such as *PC/Focus* make small data management problems trivial and large problems manageable. They encourage sound data base design by providing a variety of proven data structures, and they remove the programming drudgery from report generation by providing powerful English-like commands for that purpose.

Documentation: More Is Less

The only serious drawback to the *PC/Focus* package is its documentation. *PC/Focus*'s wide scope makes mastery of the entire system a time-consuming affair. The user manual, unfortunately, doesn't foster quick proficiency. At two volumes comprising more than 1000 pages, the manual is both gigantic and scattered.

Information Builders includes a Getting Started tutorial that, although clear, barely touches on the product's full arsenal of options. A *PC/Focus* "starter set" is also available, including enough of the program to whet your appetite but not enough to over-

```
(a) File Description for the Students file

FILENAME=STUDENT,SUFFIX=FOC
SEGNAME=STUDENT,SEGTYPE=S1
FIELDNAME=SSN,ALIAS=,FORMAT=A11,FIELDTYPE=I,$
FIELDNAME=LNAME,ALIAS=,FORMAT=A15,$
FIELDNAME=FNAME,ALIAS=,FORMAT=A15,$
FIELDNAME=ADDR,ALIAS=,FORMAT=A30,$
FIELDNAME=CITY,ALIAS=,FORMAT=A15,$
FIELDNAME=STATE,ALIAS=,FORMAT=A2,$
FIELDNAME=ZIP,ALIAS=,FORMAT=A5,$


(b) File Description for the Courses file

FILENAME=COURSE,SUFFIX=FOC
SEGNAME=COURSE,SEGTYPE=S1
FIELDNAME=CNUM,ALIAS=,FORMAT=A6,FIELDTYPE=I,$
FIELDNAME=CNAME,ALIAS=,FORMAT=A40,$
FIELDNAME=CREDITS,ALIAS=,FORMAT=F4,$


(c) File Description for the Enroll file

SEGNAME=GRADE,SEGTYPE=S1
FIELDNAME=SSN,ALIAS=,FORMAT=A11,FIELDTYPE=I,$
FIELDNAME=SEMESTER,ALIAS=SEMN,FORMAT=A6,$
FIELDNAME=YEAR,ALIAS=YR,FORMAT=I2,$
FIELDNAME=CNUM,ALIAS=,FORMAT=A6,$
FIELDNAME=GRADE,ALIAS=,FORMAT=A2,$
SEGNAME=STUDENT,PARENT=GRADE,SEGTYPE=KU,CRFILE=STUDENT,CRKEY=SSN,$
SEGNAME=COURSE,PARENT=GRADE,SEGTYPE=KU,CRFILE=COURSE,CRKEY=CNUM,$
```

Figure 6: PC/Focus file descriptions. Description (a), the file called Students, has one segment called Student. 'Segtype = S1' means that the segment is indexed on the first field. This allows it to be cross-referenced with other segments through social security numbers. Description (b), the Courses file, is indexed on the unique course number. Description (c), the Enroll file, includes cross-references for other files. The field names for the Students and Courses files do not have to be rewritten in the Enroll file description.

whelm you. For an additional fee *PC/Focus* buyers can attend a three-day class on the product. The class is offered in various locales around the country.

Armed with *PC/Focus*, you can build data bases that will continue to serve your enterprise over the long haul. The Table command and the TableTalk facility make reporting easy, and the product contains features, such as automatic data matching and virtual fields, that no PC data management system has integrated.

The mainframe version of *PC/Focus* has been through years of refinement and has emerged a winner in the highly competitive mainframe software market. It's virtually certain that other fourth-generation products will soon make a similar trip from mainframe to PC.

Warren Sirota is a data management consultant in Oakland, California.

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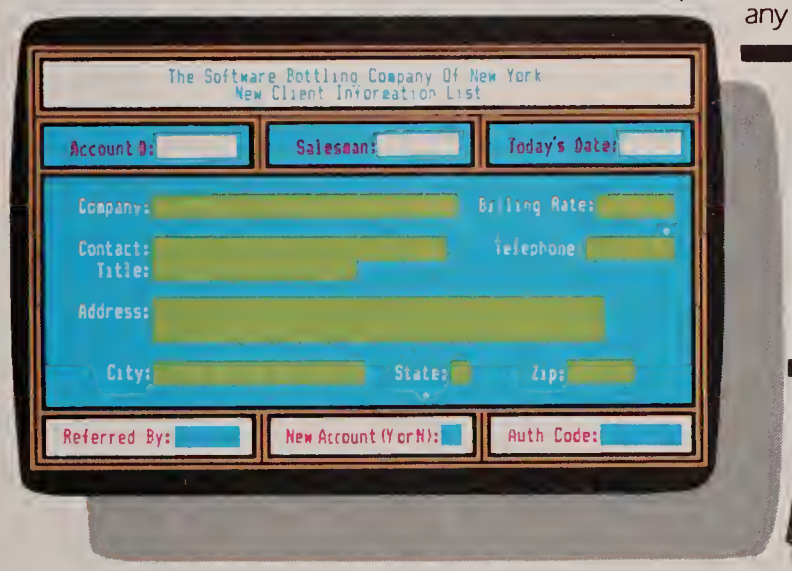

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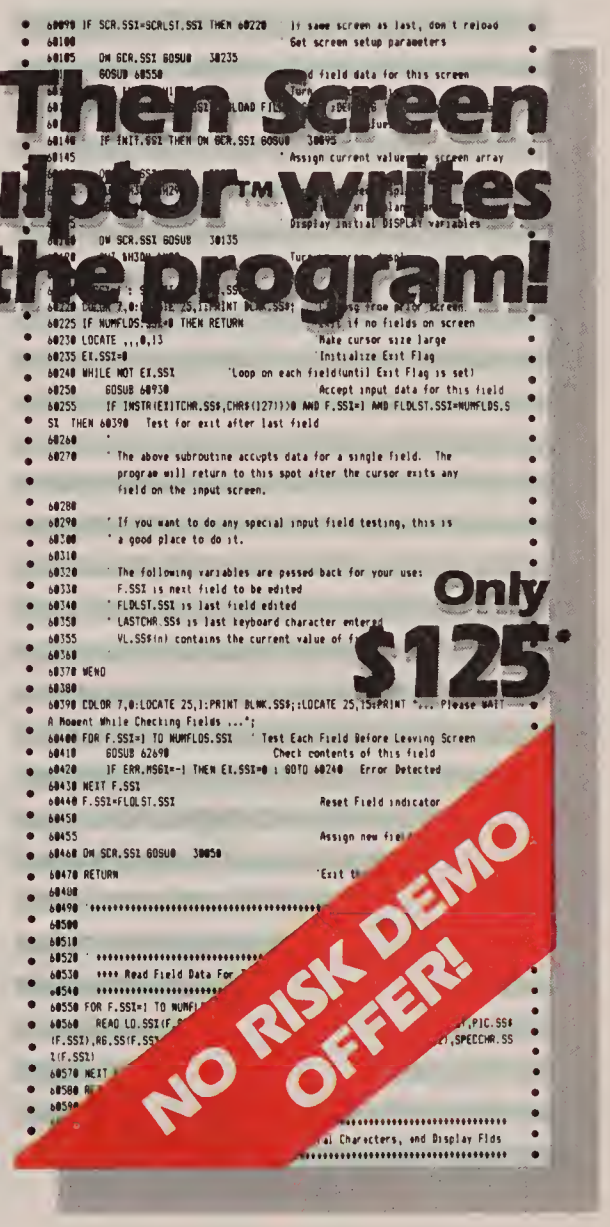

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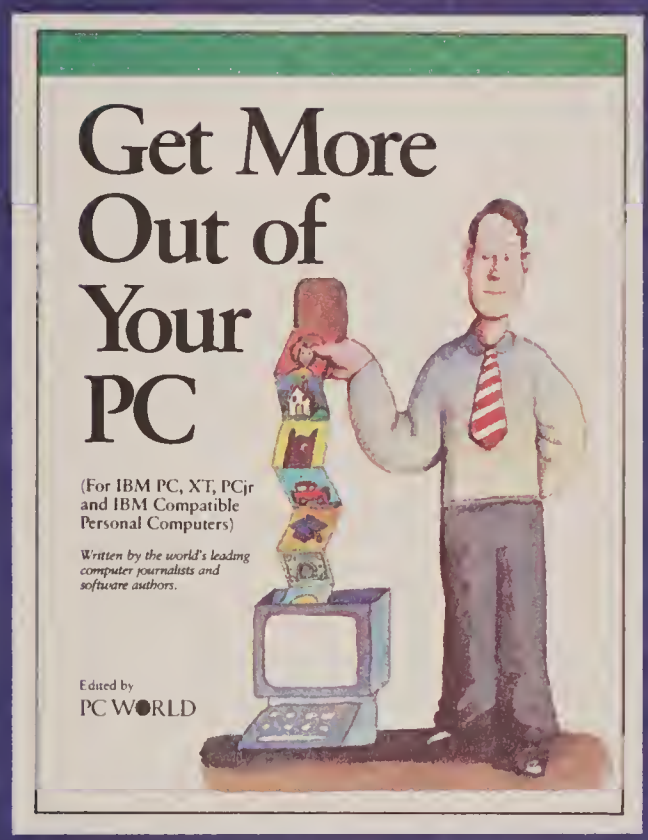

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Art Wilcox

Being a finance director isn't all it's cracked up to be, he thought. Approving budgets, staring at spreadsheets all day, and now this–searching for a network for the company's PCs. As he grimly stepped through the doors of Nets 'R Us two black cables dropped from the ceiling, wrapped around his arms, and pinned him to the wall. A salesperson caked with brilliantine lurched up and hissed, "How about a network? This 25-gigabyte-per-second token-passing beauty will support 200,000 work stations–using no repeaters! Guaranteed accuracy over 50 miles, and it's scuff resistant! No? Then run your fingers over this CSMA/CD broadband bus bomber. Fiber optics, 206 channels of video, voice, and graphics–all at 40 mps without a collision in sight! Just what you need, am I right?" The sales pitch became a grinding buzz, the room went black, weird music began to play . . .

Despite the hype and the horror stories surrounding the purchase and the implementation of a local area network (LAN), selecting one for your organization needn't be a trip into the twilight zone. But it is an exercise in determining precisely those functions that your company needs. To choose the network that will maximize productivity you must answer some basic questions: How many people will use the LAN? How much data will they need to store? How easily can you add work stations to the network? And are you limited to PCs, or can you use cheaper terminals or even other computers?

Making the best choice for your situation also requires some familiarity with the terms commonly used in the LAN marketplace. Networks are sold like high-performance cars: each is faster, sleeker, and better equipped than the competitors. You need to be able to tell the Ferraris from the Fords and, more important, which make suits your purposes. The following discussion of what makes networks go will help you approach the networking decision intelligently.

Finding Function

Your shopping trip for a PC-to-PC network will entail some of the fundamental concerns that apply to a personal computer purchase, from installation and cost to integration and training. But because networks are much less standardized than PCs, the bottom line for any network buyer is functionality: Does the network perform tasks without corrupting the data moving through it? A network's func-

tionality encompasses the ease and speed with which resources–hardware such as printers and modems as well as the hard disk holding common data–are shared. The availability of application software developed for the network is another criterion of functionality.

You'll want to familiarize yourself with a network's hardware (cables, servers, interface boards); operating system and application software, which control data sharing and data protection; installation; maintenance; vendor support; and, of course, price and performance trade-offs. Technical specifications, which deal with everything from architecture to data transfer rates, are the domain of the engineer; you need not understand them to make a sound purchasing decision. Knowing the terminology, however, may help you ward off hucksters. There's no need to lose the forest of functionality for the trees of technical mumbo jumbo (for a discussion of some of the most important LAN buzzwords, see "Net Terms.")

Dedicated servers provide faster network performance because they don't take requests from both local users and the network stations.

Hardware Heart of the Network

The raison d'être of a network is the sharing of data and resources. While strategies for doing this differ, almost all LANs have some sort of device that answers the requests that PCs in the network make for access to data or peripherals. These devices, called servers, are classified according to their uses and methods of control.

Network servers come in several guises. A central hard-disk-based computer used strictly to manage network traffic is called a dedicated server, and a computer with a hard disk (such as a PC XT) that can simultaneously be used as a local work station is called a nondedicated server. In general, dedicated servers provide faster network performance because they don't take requests from both local users and the network stations. In addition, these machines aren't susceptible to crashes caused by local users' errors–crashes that would force the network to go down. Dedicated servers are rather expensive, however, and cannot be disconnected from the network and used as stand-alone computers. Nondedicated servers potentially offer a better price/performance ratio for companies that need occasional use of the server as a local work station.

At Your Server

A high-performance dedicated server is usually proprietary, meaning that the network vendor is offering either its own hard-disk-based computer or a repackaged version of another manufacturer's machine. 3Com, for example, markets a version of the Altos 586 with its EtherSeries network. Such servers generally sport a powerful microprocessor, such as the Motorola 68000, that is suited to handling a server's tasks. Networks don't live by processor speed alone, of course. Server performance depends on a combination of processor speed, the design of the server, and the efficiency of the network operating system. Obviously, a custom network server will perform better than a reconfigured XT.

A server can be more than a central hard disk drive that stores programs and data. For example, organizations often buy a network so they can conveniently share expensive peripherals, such as laser printers. Some networks provide more orderly access to printers than others. Some may require the use of a print server, which mediates between the PCs and printers and establishes priorities for access. Other networks get the job done with print server software. Remember, however, that even though software may cost less than hardware, it can still be expensive. In addition, find out how many printers and what type–serial or parallel–the server will support.

Some servers provide functions that, although not required today, may be needed in the future. Communications servers allow networked PCs to access remote computers and data base resources; gateway servers connect dissimilar networks or mainframe computers to your network–an important service for corporate users who need to tap into mainframe data bases and processing. You may want to

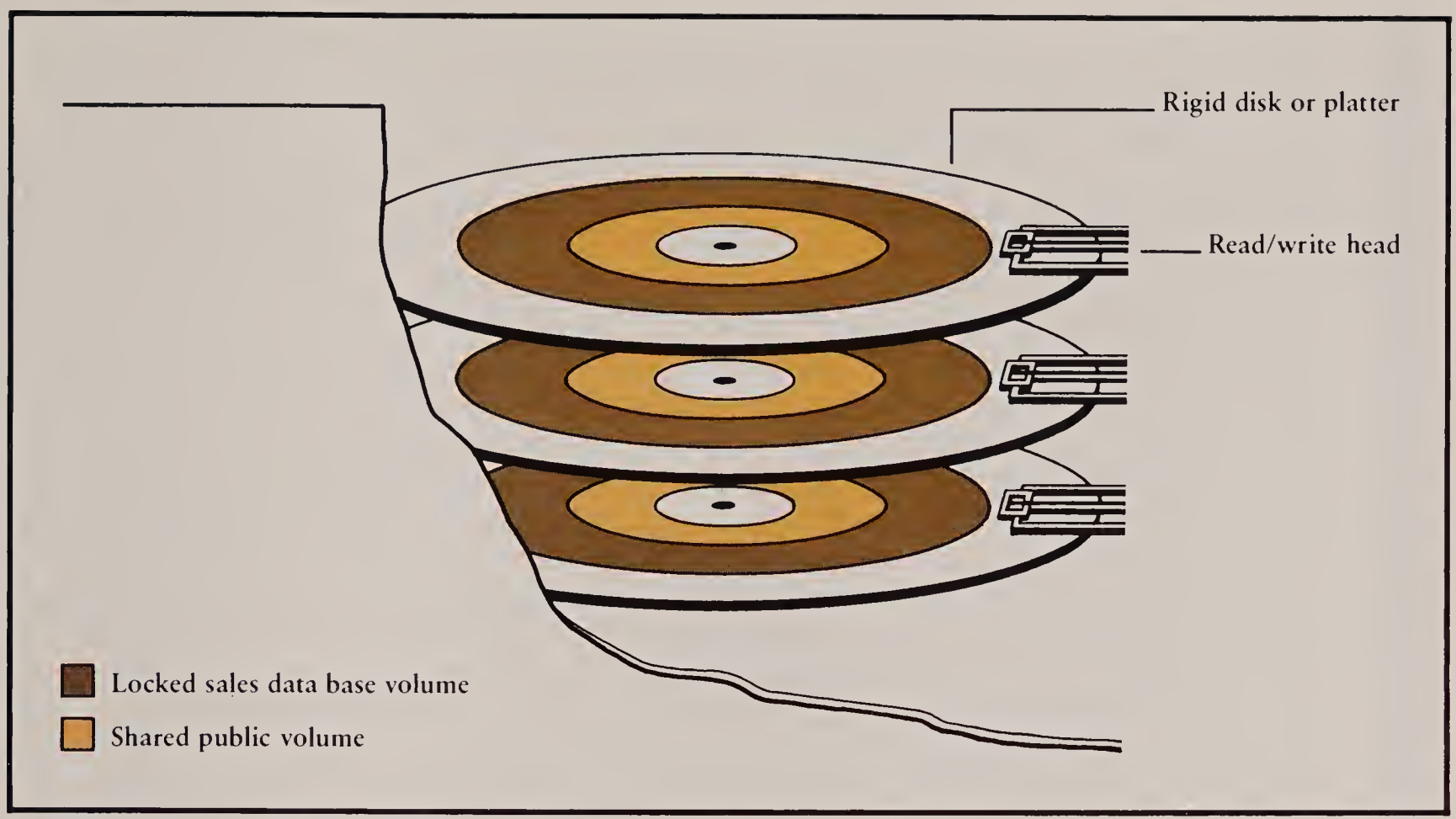

Figure 1: An example of several volumes on a hard disk network server. Each volume is essentially a cylinder that passes through each rigid disk, or platter, in the drive. Each volume can be reserved (locked) for a particular user in a network and acts like an extra disk drive.

create servers for special applications. For example, if a network is used mostly with data management programs, it may pay to assign a PC XT in the network to be a sort server.

Plugging In

Not every network needs a dedicated server, but all require that each PC be connected to the network with an interface board and a particular kind of cable. Most network interface boards cost between $295 and $1000 and include a high-speed microprocessor that prevents the PC's own 8088 microprocessor from being overloaded. In some instances installing a network board means removing an expansion board, because functions provided by the two may overlap, playing havoc with the host PC. Keep in mind, too, that even the most compatible computers, such as the Compaq, may not work in a PC network.

The three most popular cable media available to hook PCs together are inexpensive twisted pairs of copper wire, more expensive coaxial cable, and very expensive fiber-optic cable. The type of cable that comes with a network depends on the network's size, your applications, and the network environment, as dictated by topology and protocol. You can rarely choose the cable for a given network because vendors usually bundle cable with their products.

Software Soul of the Network

The network operating system is the key that locks and unlocks network resources. It determines a network's usefulness by defining how easily and to what extent each user can gain access to those resources. A cleverly written operating system can compensate for a multitude of network sins; conversely, the fastest server and the most advanced cabling system are wasted if the network operating system is poorly crafted.

Most network operating systems simply split the server's hard disk into sections called volumes, which are then assigned different levels of user access by the person charged with managing the network (see Figure 1). Volumes are usually assigned public status (meaning everyone has read-only access to

Net Terms

Although you don't have to be a whiz at network theory to buy a LAN, the more you know, the better off you are. Keep in mind that this primer isolates a number of technical ingredients that network manufacturers tend to blend into a single product. That marketing practice blurs distinctions and renders moot some questions, such as "Should we go with a ring network using token passing?" A discussion of several key elements of local area networking– topologies, protocols, data rates, and bandwidth and cabling–follows.

Topology. Local networks come in three geometric layouts: bus, ring, and star. On bus networks all terminals and servers share the same cable. An interface board is simply slipped into one of the slots in the back of each computer's motherboard or bus. Network signals branch out in both directions to reach every PC, hard disk, and peripheral on the network. Ring networks consist of a closed circuit of computers, each with a repeater that "pushes" the signal to the next PC on the circuit. Messages go from station to station until they reach their destination or return to the originating PC. In a star network each station has a direct line to the server (central computer), much like the distributed systems of yesteryear. Every dispatched message must pass through the central computer before it can travel on to another work station.

Protocol. A network must have a way to allocate access to its resources in an efficient manner. Although several methods are available, most networks rely on either token passing or the CSMA/CD scheme, which stands for carrier sense multiple access with collision detection.

In the CSMA/CD method a work station PC "listens" to the line for a message signal. If no signal is present, the PC sends its message (be it a request for data or a file to print) and monitors the line to check whether the message is garbled by another message on the line. If a "collision" occurs, the PC halts transmission (as does the source of the conflicting message) and alerts all network stations of the collision. Both stations involved in the collision wait a specified amount of time (as predetermined by network software) before retransmitting their messages.

The token ring scheme circulates a token, or electrical signal, around the network until a station wanting to transmit "grabs" it. The station attaches its message, complete with the recipient's address, to the token and returns it to the network. The addressee then "copies" the token's message and sends it on to the next station. The PC that originated the message determines whether it arrived intact by reading it when it completes the circuit. The token is then cleared and returned to the network.

Data rates. A local area network that pushes data at 10 megabits per second is more powerful than one in which data moves at 2 megabits per second. True or false?

The answer is–maybe. LAN data rates, like automobile horsepower, can be misleading indicators of a network's efficiency and overall perfor-

mance. For example, the Ethernet LAN has a 10-megabits-per-second data transfer rate. But because it uses the CSMA/CD protocol, if many people use the network at the same time there's a great likelihood of collisions. The result? An effective data rate of perhaps 1 megabit per second.

A high data rate can be overkill if other devices on the network—notably the server and the interface board in a local PC—can't handle that much data at once and thus become bottlenecks. Network performance remains a synthesis of all of the elements in a LAN—the hard disk, the operating system, the processor, the cabling, the topology, the protocol, and the data rate that a given combination of these elements permits. Don't be swayed by megabits per second.

Bandwidth/cabling. The term *bandwidth* describes the range of frequencies that can move over a circuit such as the cable connecting PCs in a network; local nets are either baseband or broadband. Broadband systems, which carry a host of different frequencies over a single cable, are much more expensive than baseband ones (which carry a single digital signal) because elaborate circuitry is required to differentiate between the various frequencies. In addition, each work station on a broadband network requires a translation device that converts the computer's digital signal into an analog frequency and back again. Although they're normally inexpensive, such devices can be costly for some high-speed channels.

If your organization needs the ability to transmit data in various forms, including videotex, voice mail, or video conferencing, a broadband LAN may be your best investment. Consider too that IBM is taking two approaches: a broadband PC-based network and a baseband token ring network using twisted pair cabling (due out by 1986) that would link PCs, minis, and mainframes. Before you decide on a specific network, assess the types of data that you want to share. Remember that choosing between baseband and broadband technology entails trade-offs in performance, expandability, and ease of installation.

The network cable itself affects each of those elements, as well as network price. Of the three media available (twisted pair, coaxial, and fiber optic), twisted pair is the least expensive and easiest to install in office settings. It is also the most susceptible to electrical "noise" caused by other machines in the area. A twisted-pair network generally has lower data rates and shorter maximum distances than networks using one of the other media. Coaxial cable offers higher data rates and longer distances than twisted pair, greater immunity from interference, and compatibility with cable TV wire. However, coaxial cable is more expensive and harder to install. Fiber-optic cable is spun glass that transmits data via a beam of light. It provides exceedingly high data rates and immunity from interference, but its current cost precludes widespread use. Fiber-optic cable is also susceptible to damage from physical shock and can send data in only one direction at a time.

files), private status (a single user has both read and write access), or shared status (all users have both read and write access, although networks handle simultaneous access in different ways). Some networks allow a greater number of access levels than others; for example, Novell's operating system lets you assign one of nine security levels to a file. A user might have the power to delete or create files or, at the other extreme, no access to certain volumes or files. In between might lie security levels that allow users to read a file but not change it or to enter data in a file they cannot view the contents of.

Access is a key network issue. You want to share data, but you don't want to trample on anyone else's, and you certainly don't want anyone mangling yours. The meaning of *access to shared volumes* varies from network to network. Under an access level known as volume locking, one user opening a file effectively bars all others from accessing any part of the volume. Some networks allow several users to view and modify different files within the same volume, a technique called file locking. Certain file-locking schemes permit several users to read but not write to the same file.

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Under the most precise level of network data access, known as record locking, only parts of files are locked. Users can simultaneously use the same file in a volume but are prevented from writing over the same records. True record locking is rare. It's also important to note that all locking schemes depend on both the network operating system and the application software that runs under it. Most network operating systems support record locking, but the application programs must be written to take advantage of this feature.

Each level of access has its uses. A law office that uses computers primarily for document preparation rather than for client data bases or billing purposes doesn't necessarily need a LAN with file- or record-locking capabilities; it can share the word processing program on a public volume and benefit from the convenience of shared high-speed printers and high-capacity hard disk drives. If the attorneys decide that they need simultaneous access to the same volumes as their clerks, however, file locking becomes necessary to ensure the integrity of all shared data. If the office wants to automate its client list and case histories, record locking will maintain the security of the shared data conveniently.

Mixing Apples, Oranges, and Blues

Sharing data among similar computers is one thing; accomplishing that task among dissimilar machines is a bit more difficult. If your business is like most, it has moved into personal computing on an as-needed basis, and machines have been acquired piecemeal. Along with PCs and PC compatibles, you may have Apples, Kaypros, or Radio Shack computers. Linking these machines may be desirable, but it's unlikely that any LAN could enable all the machines to talk to each other. The linking capability is a function of both the network interface boards and the network operating system. Orchid Technology's PCnet, for example, is confined to PCs and PC-compatible computers. Other LANs, notably Corvus's Omninet, can link computers that use different operating systems and microprocessors. Such systems, however, are like people of different nationalities living in a hotel—sharing the same roof does not mean sharing the same language.

LANs that permit dissimilar computers to intermingle usually do so by the aforementioned disk partitioning method; each Apple IIe or PC is assigned to a separate volume that contains its own operating system and user files. Unfortunately, at this stage in LAN technology, the only way such diverse systems can share data is via special software written for that purpose. Be wary of claims, then, that a given network will single-handedly interpret the electronic Tower of Babel.

Station Breaks

The number of work stations a vendor claims its LAN will support has "buyer beware" written all over it. Some network vendors publish astronomical figures on the maximum number of nodes (devices) that a LAN can supposedly support. (The claims go as high as 64,000.) Be wary of any number over 10; it's apt to be a theoretical maximum that refers to the total number of nodes the network can physically address. The functional limit is much lower and depends on how often the stations access the LAN and how well the server pushes data around the network.

Figures cited for "maximum distance between stations" tend to be realistic, however, and most note where repeaters are necessary. To a greater degree than the number of nodes, the distances between stations are subject to limits imposed by the laws of physics—in other words, a signal can go only so far.

Where's the Programs?

The question that faces every personal computer buyer also dogs the LAN purchaser: what software runs on which system? Many off-the-shelf PC programs will run smoothly on a PC-compatible network, but few are designed to really take advantage of a LAN's data-sharing environment or to protect themselves from the risk of data loss. You may be able to load *pfs:file* on a network server and use it across the network, but the program won't let you prevent two users from accessing the same file. Even if a network's operating system permits you to specify how a file is shared, data protection is the application program's job—one that many programs cannot do. Another cautionary note: running single-user applications across a network can constitute a copyright violation. Your best bet is to check with the vendor for applicable multiuser licensing agreements (or schedules).

Bringing out the full functionality of a network is the province of software designed specifically for multiple users. Unfortunately, the growth of multiuser software hasn't kept pace with the proliferation of other network products. There is, however, a slow and steady trend toward modifying existing data management and accounting packages as well as toward writing entirely new programs for network settings. Some networks sell bundled multiuser packages. Nestar, for instance, offers *LAN:Datastore* and a version of *SuperCalc 3*. It's caveat emptor once again, because the mere designation *multiuser* doesn't guarantee real data sharing; it usually does, however, mean a higher price tag. Before purchasing multiuser software, ask your vendor (or the manufacturer) to demonstrate the software on the desired network and to provide a list of clients whose network installations are apt to resemble yours. If the vendor can't or won't demonstrate the program with a representative number of network work stations, get a written guarantee that spells out how many users the software will support, at what activity level, and how performance will change as users are added. If the vendor won't provide a guarantee, don't be a guinea pig at your own expense.

Up and Running

Buying a network is considerably easier than getting it to work. Before you buy, recognize that the LAN implementation process encompasses hardware installation, software installation, and training in both hardware and software. To accomplish these steps, some businesses may need to retain a consultant temporarily.

Hardware installation. LAN cable isn't likely to be expensive, but installation can be. Depending on your building and the type of cable used, laying down cable can be a major project or as simple as running a phone extension cord into the next room. Cable can be routed along or inside walls, inside electrical conduits attached to walls, above suspended ceilings, under elevated floors—even in covered channels cut into the floor. Unless your LAN installation coincides with office relocation, these methods can require expensive office renovation and even impair office productivity as a contractor lowers ceilings, raises floors, or digs cable channels throughout the building. Consider, too, that the most attractive installation method may be impossible in light of building and fire codes or restrictions imposed by your lease.

Software installation. Once installed, the operating system and application software should demand minimal intervention by network users. For common tasks such as word processing, for instance, users should need few commands to access files or use shared peripherals. A network shouldn't require long

or complex commands; if it does, the commands should be placed in batch files so that users won't need to spend time mastering them and repeatedly keying them in. If you're dealing with a value-added reseller, setting up menus, writing batch files, and installing LAN software should be covered by the network's purchase price; if not, you will need to hire full- or part-time professional help. Day-to-day management of the network can be left to a full- or half-time employee. Before you install the LAN, consider how much time this employee (known as the system manager) will have to dedicate to the network each day. Don't put all your network management eggs in one basket, either; make sure several employees are trained to fill the job.

LANs should come with well-organized, indexed, and clearly written manuals for both network users and the system manager.

Training. Some LAN-specific training is essential, especially for network applications such as electronic mail or multiuser data management programs. Does the LAN vendor include training with a network purchase, or will you need to hire an instructor? Will the training be available at your office or at a training center?

Your road map to the LAN implementation process is the network's documentation. LANs should come with well-organized, indexed, and clearly written manuals for both network users and the system manager. The documentation should amply illustrate hardware installation procedures and include concise explanations of how to use the software. If you (or your data processing department) are planning to manage the LAN, the documentation should also include technical and maintenance manuals. In addition, tutorials and on-line help screens make learning easier for all users.

Experienced network managers suggest that any prospective user get a copy of the system's documentation before making a purchase decision. After wading through the manuals you will have a better idea of what to expect and what to ask the network vendor.

Net Maintenance

How much energy and money you devote to maintenance depends on the complexity of the LAN you choose. A part-time network supervisor can probably manage a small baseband network used primarily for word processing and sharing printers and hard disks. Such an assignment might consist of monitoring the LAN (by adding work stations and volumes) and troubleshooting using network utility programs. A large broadband network with 100 users dispersed throughout a skyscraper, however, will require a LAN manager with top-flight technical and programming skills. A large, sophisticated network may even need special monitoring hardware that costs as much as the network itself.

Vendor Support

Because networks often combine devices from several manufacturers, you should consider who will repair or replace any equipment that breaks down. The critical link in the chain is the network server and its companion backup unit. If a server fails, vital company data may be at risk. If the backup unit is specially made by your network vendor (either incorporated in the server itself or freestanding), you may not be able to access your backup files until a replacement server is obtained. Find out how the vendor of a network under consideration would respond to such a situation; for example, would the vendor loan or rent an identical server to you during the emergency? Inquire about the availability of third-party maintenance contracts, and check into purchasing your sys-

tem from a value-added reseller. Such organizations usually provide service from the time of sale–installation, training, software customization, and ongoing support–at an additional cost.

Although LAN reliability can be difficult to assess, see if the vendor will supply figures for "mean time between failures" and "mean time to repair" for all network components. Try to find out about possible glitches in equipment by seeking out those who have networks in place. Vendors (or manufacturers) are obvious sources for such references and will often release names of satisfied clients.

Price and Performance

Before committing resources to a LAN, it's natural to weigh cost versus value received. How much does sharing data improve productivity? How much do you save by sharing peripherals? Like everything else about LANs, cost is slippery. A network's initial hardware and software costs are straightforward and easily computed. But the more subtle, often hidden costs of training, installation, and maintenance may pose an even greater threat to budgets than the visible portion of the network iceberg.

The network selection process is a complex one and often justifies the retention of a professional consultant. Finding the right individual for that job can be as difficult as locating a good mechanic or physician and as important (see "The Organization LAN" in this issue). A good consultant can assist not only in the selection of a network but also in its proper installation, configuration, and customization.

Although you may still not have all the answers, you're now probably better equipped to ask the right questions. Learning the ropes and cables today will spare you headaches and save you money tomorrow–and eliminate that trip into the network twilight zone.

Art Wilcox is a freelance writer and telecommunications consultant living in San Francisco.

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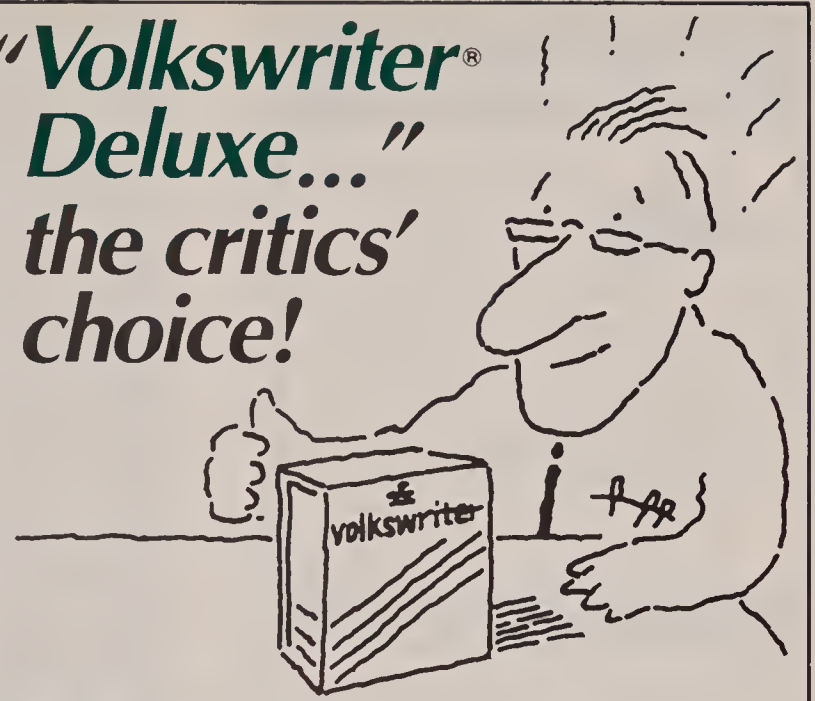

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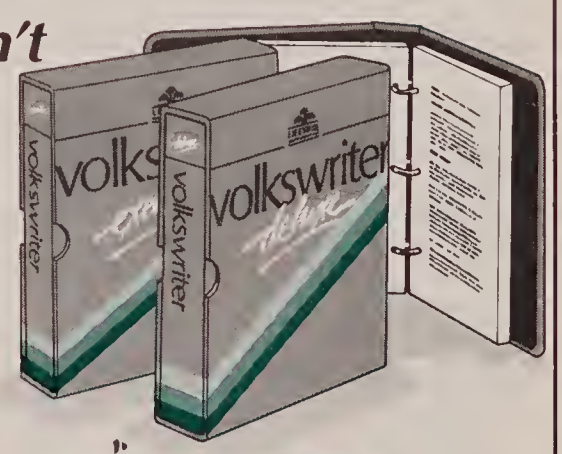

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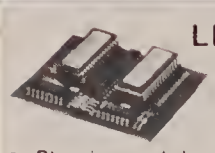

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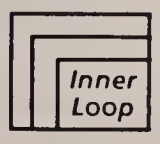

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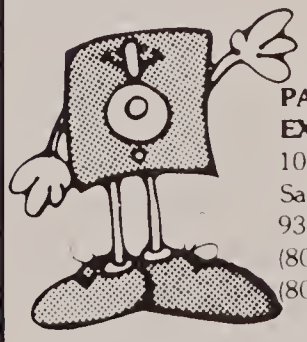

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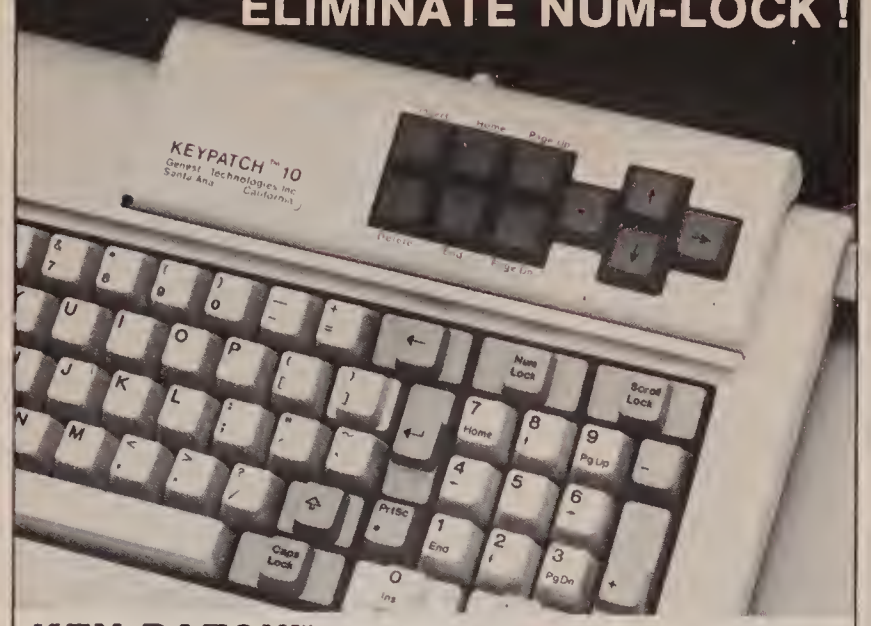

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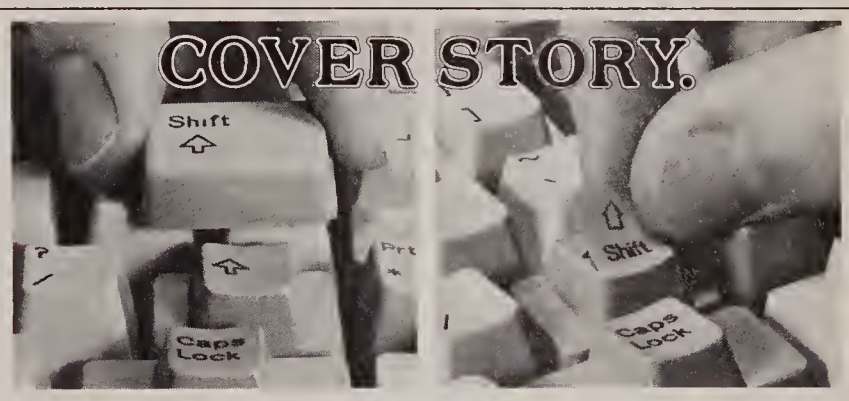

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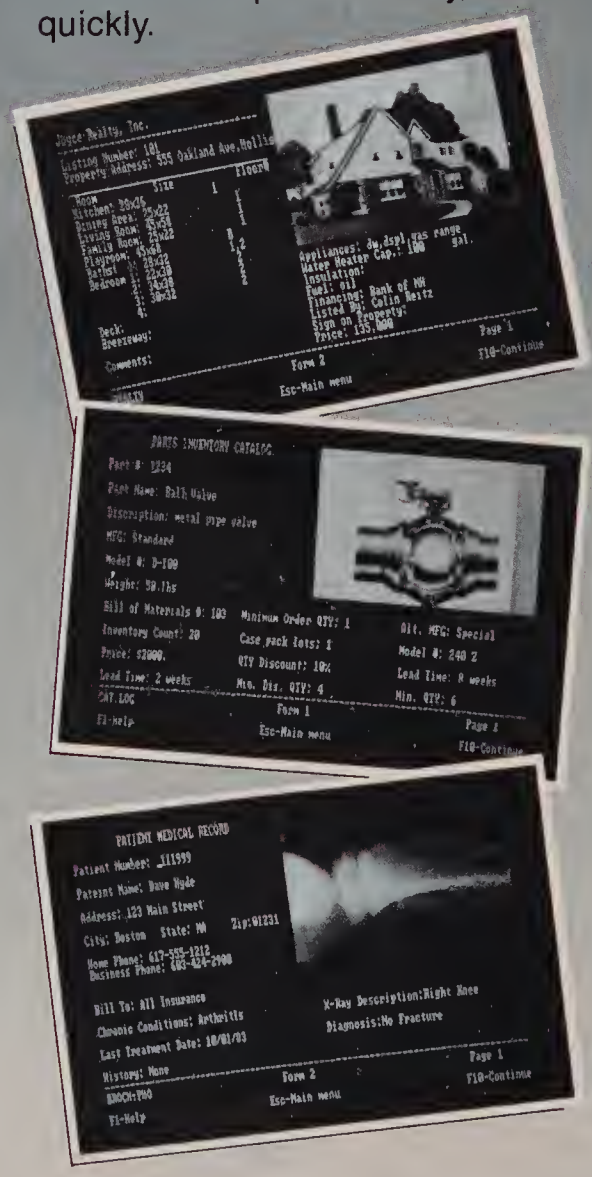

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Star-Dot-Star

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This month our readers' submissions include tips on running dBASE II in color and a dBASE routine that draws boxes

Edited by Steven Cook

dBASE Displays

The *dBASE II* SET COLOR command allows a user to set separate video attributes for data displayed by the program and data typed by the user. The format of the command is SET COLOR TO *get, say,* where *get* is the attribute assigned to GET statements (data typed by the user) and *say* is the value assigned to SAY statements (data displayed by the program).

I have found that DBVIDEO [Table 1] is a very useful tool for determining values for *get* and *say.* It works for *dBASE II,* version 2.4, and probably later versions as well.

Michael Gilbert
San Francisco, California

dBoxes

The listing MAKEBOX is a *dBASE II* program that draws boxes using the horizontal, vertical, and corner characters of the IBM PC character set. The input to the program must be set to indicate the starting row and column position for the box and the number of rows and columns for its height and width. The statements shown in DBOX demonstrate the MAKEBOX program.

Raymond Sarnowski
Pittsburgh, Pennsylvania

The Wild Type

The TYPE command in DOS, versions 2.00 and later, does not allow question marks and asterisks to indicate a group of files. To make those wild-card characters usable, I have created a batch file called TY.BAT that consists of the following line: **COPY%1 CON**:. I chose the name TY because it's the command used on many mainframes to display files.

Edward Fischer
New York, New York

```
*********************
*      MAKEBOX      *
*********************

* A = Upper Right Corner
* B = Horizontal Bar
* C = Upper Left Corner
* D = Lower Right Corner
* E = Lower Left Corner
* F = Vertical Bar

STORE CHR(201) TO A
STORE CHR(205) TO B
STORE CHR(187) TO C
STORE CHR(188) TO D
STORE CHR(200) TO E
STORE CHR(186) TO F

STORE RR TO ROW
STORE CC TO COL

@ ROW,COL SAY A
@ ROW+RI,COL SAY E
@ ROW,COL+CI SAY C
@ ROW+RI,COL+CI SAY D

DO WHILE COL<CI+CC-1
   STORE COL+1 TO COL
   @ ROW,COL SAY B
   @ ROW+RI,COL SAY B
ENDDO
STORE CC TO COL
DO WHILE ROW<RI+RR-1
   STORE ROW+1 TO ROW
   @ ROW,COL SAY F
   @ ROW,COL+CI SAY F
ENDDO
RETURN
```

MAKEBOX: A dBASE II subroutine for drawing squares and rectangles

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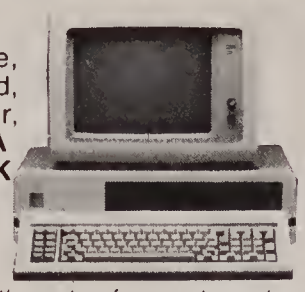

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Table 1: Values for the dBASE II SET COLOR statement

Intensity	Flashing	Underlined	Reverse	Value
Blank				0
Low				7
High				15
Low		xxx		1
High		xxx		9
Low	xxx			135
High	xxx			143
Low			xxx	112
High			xxx	120
Low	xxx	xxx		129
High	xxx	xxx		137
Low	xxx		xxx	240
High	xxx		xxx	248

```
*********************
*        DBOX       *
*********************

INPUT "LEFT CORNER-ROW" TO RR
INPUT "LEFT CORNER-COLUMN" TO CC
INPUT "NUMBER OF COLUMNS WIDE" TO CI
INPUT "NUMBER OF ROWS DEEP" TO RI
DO MAKEBOX
RELEASE RR,CC,CI,RI,A,B,C,D,E,F,ROW,COL
RETURN
```

DBOX: A dBASE II program that demonstrates the MAKEBOX subroutine

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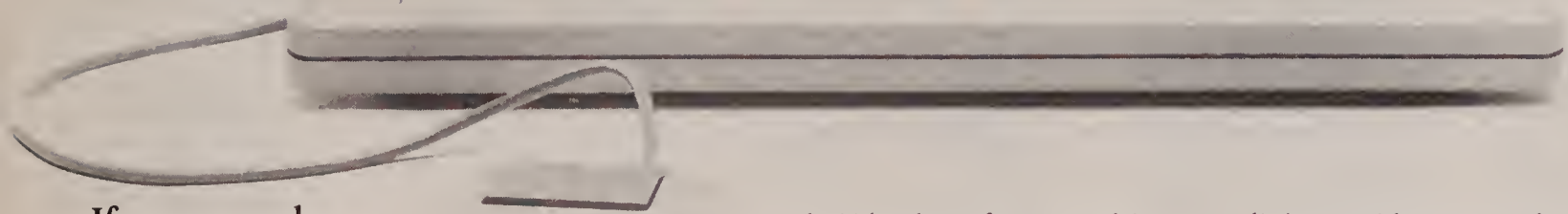

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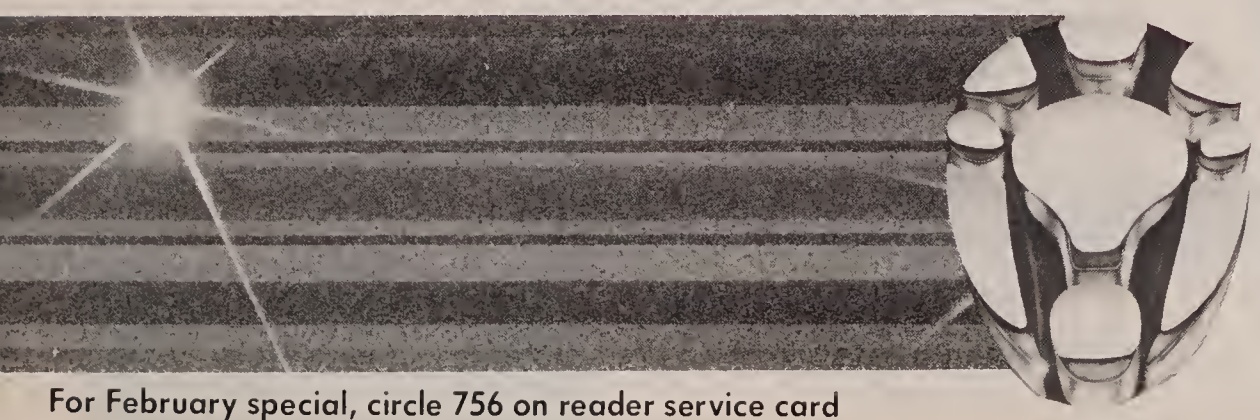

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Listings

Example programs from the articles in this issue

```
10 REM ******  CASTLE.BAS  *******
20 CLEAR ,,,32768!: SCREEN 5: KEY OFF: CLS: PALETTE
30 REM ******DRAW WALL AND LEFT TOWER******
40 LINE (70,70)-(220,140),7,B
50 LINE (45,140)-(70,65),7,B
60 LINE (40,30)-(75,60),7,B
70 LINE (40,60)-(45,65),7
80 LINE (75,60)-(70,65),7
90 PAINT (71,72),8,7
100 PAINT (46,61),8,7
110 PAINT (46,66),8,7
120 PAINT (41,31),8,7
130 LINE (35,30)-(57,2),4
140 LINE (57,2)-(80,30),4
150 LINE (35,30)-(80,30),4
160 PAINT (60,10),CHR$(&H4C)+CHR$(&HC4),4
170 REM ******DRAW MORE TOWERS******
180 LINE (220,120)-(240,110),7
190 LINE -(240,50),7
200 LINE -(220,50),7
210 LINE -(220,70),7
220 PAINT (230,80),8,7
230 LINE (215,50)-(230,15),4
240 LINE -(245,50),4
250 LINE -(215,50),4
260 PAINT (225,40),CHR$(&H4C)+CHR$(&HC4),4
270 LINE (170,70)-(190,40),7,B
280 PAINT (180,60),8,7
290 LINE (165,40)-(180,10),4
300 LINE -(195,40),4
310 LINE -(165,40),4
320 PAINT (180,20),CHR$(&H4C)+CHR$(&HC4),4
330 REM ******DRAW WINDOWS******
340 CIRCLE (150,110),20,7,0,3.14159
350 LINE (130,110)-(130,140),7
360 LINE (170,110)-(170,140),7
370 CIRCLE (50,40),3,14,0,3.14159
380 LINE (47,40)-(47,50),14
390 LINE -(53,50),14
400 LINE -(53,40),14
410 PAINT (50,45),14
420 CIRCLE (230,60),3,14,0,3.14195
430 LINE (227,60)-(227,70),14
440 LINE -(233,70),14
450 LINE -(233,60),14
460 PAINT (230,65),14
470 CIRCLE (180,50),3,14,0,3.14195
480 LINE (177,50)-(177,60),14
```

(continues)

Color on Command
From page 184
CASTLE.BAS

Color on Command
From page 184
CASTLE.BAS
(continued)

```
490 LINE -(183,60),14
500 LINE -(183,50),14
510 PAINT (180,55),14
520 REM ******DRAW `MOUNTAIN'******
530 LINE (0,199)-(25,162),8
540 LINE -(45,141),8
550 LINE -(220,141),8
560 LINE -(280,170),8
570 LINE -(319,199),8
580 PAINT (160,180),CHR$(&H82)+CHR$(&H28),8
590 REM ******DRAW LIGHTENING BOLT******
600 LINE (0,0)-(53,5),15
610 LINE (61,6)-(70,8),15
620 LINE -(150,20),15
630 LINE -(170,30),15
640 LINE (150,20)-(160,30),15
650 LINE -(155,40),15
660 LINE -(160,68),15
670 LINE (160,30)-(165,68),15
680 LINE (125,17)-(145,40),15
690 LINE -(150,68),15
700 A$=INPUT$(1)      'PAUSE FOR KEYSTROKE
710 PALETTE 14,3      'CHANGE YELLOW WINDOWS TO CYAN
720 PALETTE 0,1       'CHANGE SKY FROM BLACK TO BLUE
730 PALETTE 15,1      'CHANGE WHITE LIGHTENING BOLT TO BLUE
740 A$=INPUT$(1)      'PAUSE FOR KEYSTROKE
750 PALETTE 14,14     'TURN ON LIGHTS IN WINDOWS
760 PALETTE 15,0      'CHANGE LIGHTNING BOLT TO BLACK
770 PALETTE 0,0       'CHANGE SKY BACK TO BLACK
780 PALETTE 2,0       'CHANGE GREEN IN GRASS TO BLACK
790 PALETTE 7,0       'ERASE WHITE LINES IN CASTLE DRAWING
800 LC=14
810 FOR A=0 TO 1000: NEXT
820 FOR A=0 TO 6
830    PALETTE 15,15  'TURN LIGHTENING BOLT BACK TO WHITE
840    FOR B=0 TO 10: NEXT
850    PALETTE 0,15   'TURN ENTIRE SKY WHITE FOR FLASH
860    FOR B=0 TO 5 : NEXT
870    PALETTE 15,0   'TURN LIGHTENING BOLT OFF BY GOING TO BLACK
880    PALETTE 0,0    'TURN ENTIRE SKY BACK TO BLACK
890 NEXT
900 A$=INPUT$(1)                    'PAUSE FOR KEYSTROKE
910 IF A$="L" OR A$="l" THEN GOSUB 940: GOTO 900
920 IF A$="Q" OR A$="q" THEN PALETTE: END     'QUIT
930 IF A$=CHR$(32) THEN 820  ELSE 900
940 IF LC=0 THEN LC=14 ELSE LC=0
950 PALETTE 14,LC     'TURN WINDOW LIGHTS ON AND OFF
960 RETURN
```

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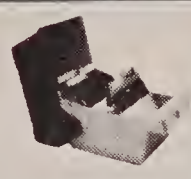

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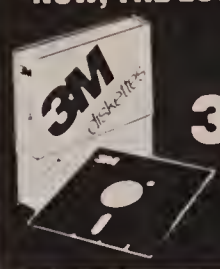

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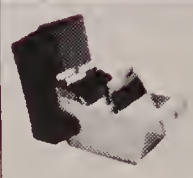

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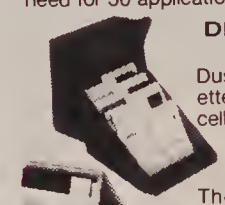

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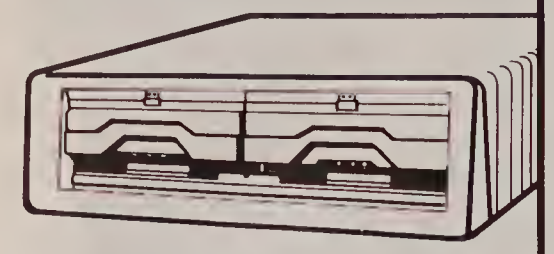

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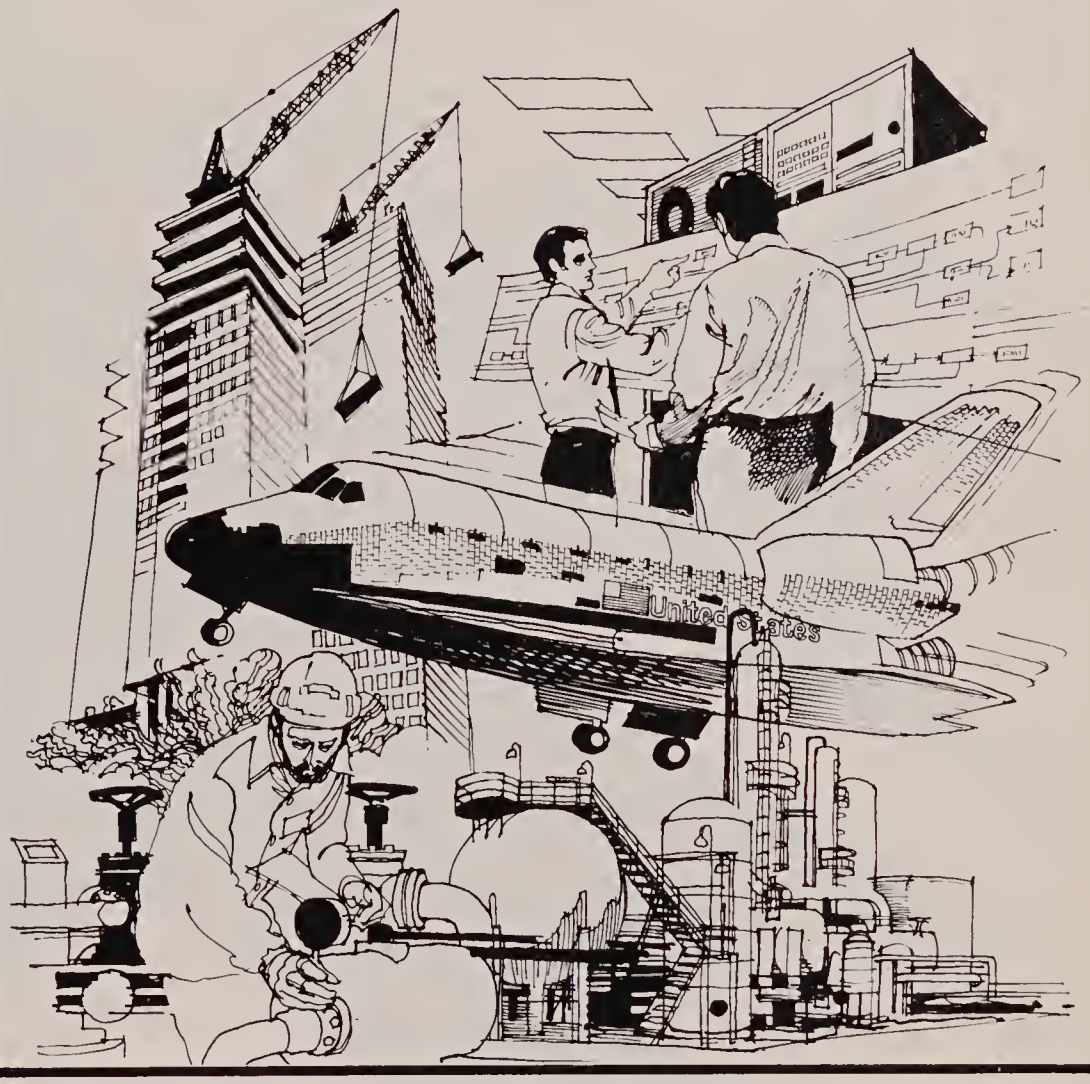

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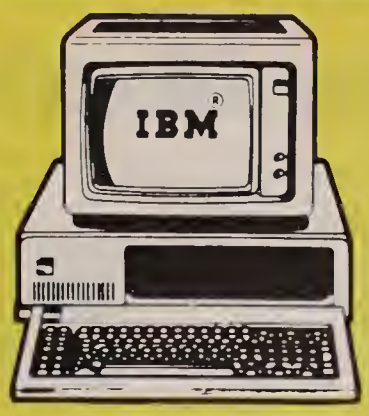

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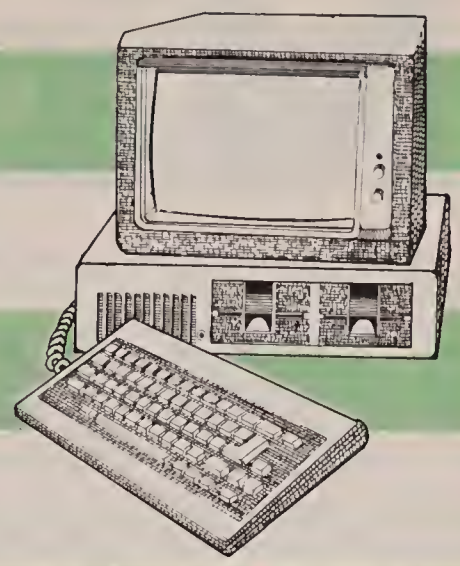

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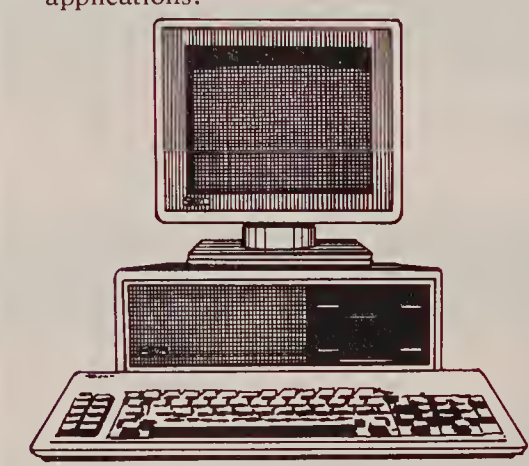

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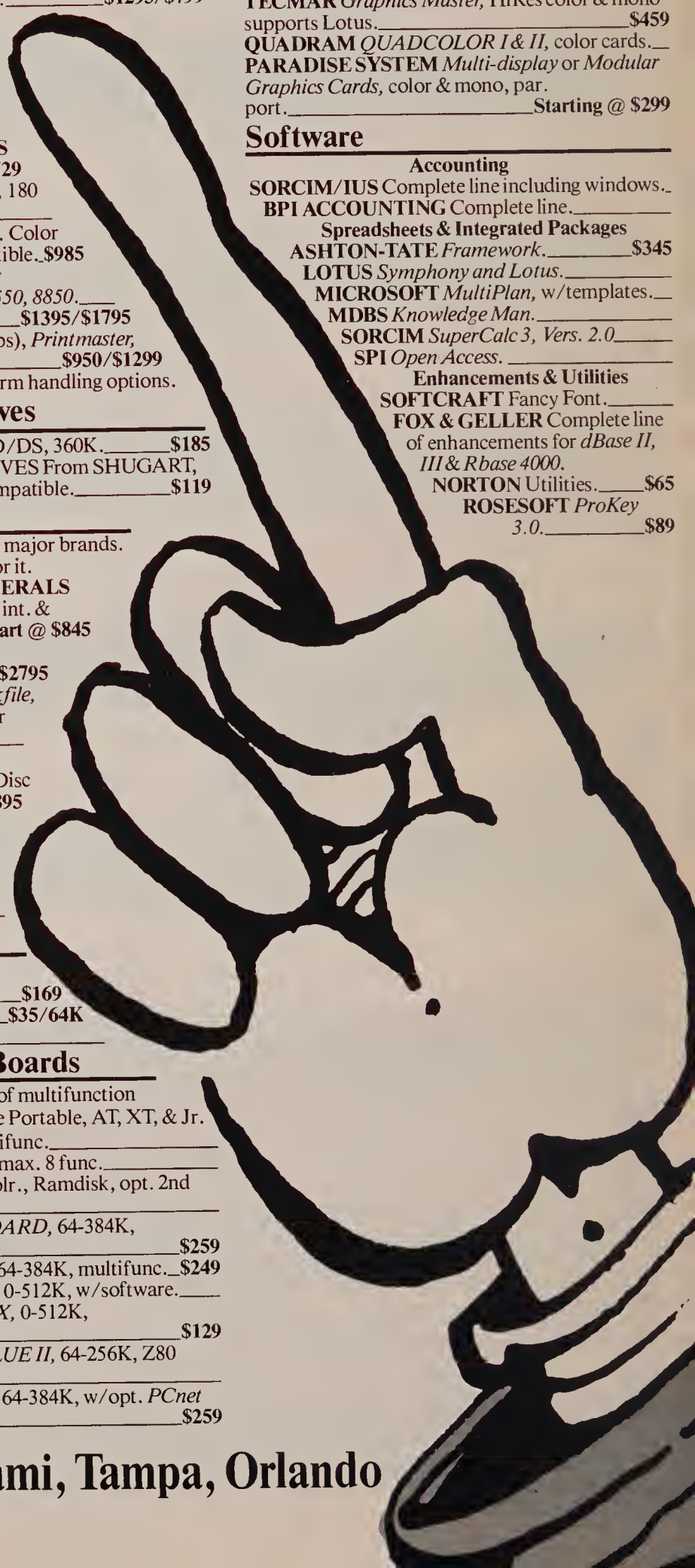

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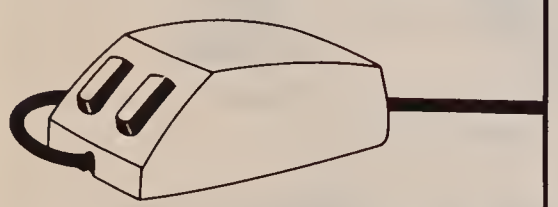

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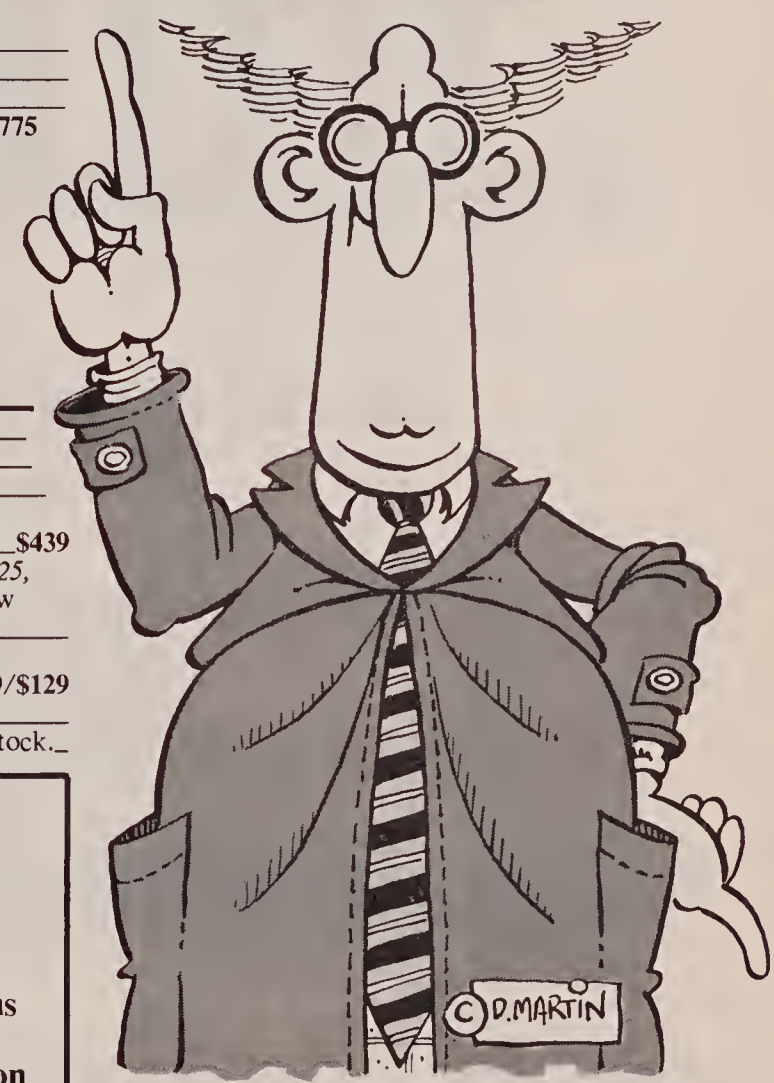

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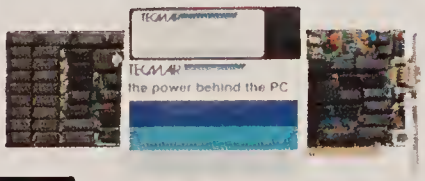

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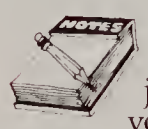

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☐ VISA ☐ MC ☐ AMEX Signature

Acct. No. Exp. Date

Bellsoft, Inc., 2820 Northup Way
Bellevue, WA 98004
(206) 828-7282

Cash value 1/20¢